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ENGINEERING REFERENCE MANUAL *gr*
FOR
PROPELLANT ACTUATED DEVICES (PAD)



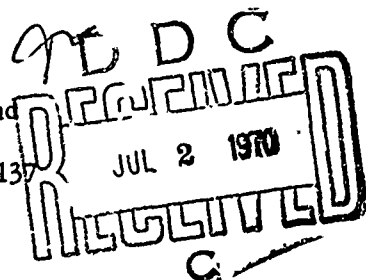
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Philadelphia, Pa. 19137

PAD Laboratories
U. S. Army Munitions Command
Frankford Arsenal
Philadelphia, Pennsylvania 19137



FOREWORD

This Engineering Reference Manual for Propellant Actuated Devices (PAD) is primarily a catalog which provides technical information on over 175 PAD items.

Those items prefixed by an "M" have been type classified as standard and are available as normal production hardware. In addition, certain items are listed that have not reached type classification and are prefixed by an "XM".

In addition, this manual contains a section relating to other specialized activities of the PAD Laboratories such as technical consulting services and Ballistic Testing. () X

PROPELLANT ACTUATED DEVICE

BACKGROUND HISTORY

In the early 1940's the advent of high speed military aircraft posed the problem of how to get a pilot out of a disabled aircraft, since he could no longer crawl out and manually parachute himself to safety.

For a solution to the problem, the then Army Air Corps looked to the Army Ordnance and it turned to Frankford Arsenal. Thus, commencing in the summer of 1945, Frankford Arsenal collaborated on the design and development of the first ejection seat catapult. Two years later this catapult was standardized as the M1 Personnel Catapult. In 1947, soon after the standardization of the M1 Personnel Catapult, the design and development of the first propellant actuated canopy removers, the M1 and M2, was completed. Later, in 1949 Frankford Arsenal developed the first propellant gas pressure generator source, the M1 initiator. Since then over 175 different Frankford Arsenal propellant actuated devices have been designed, tested, standardized and used in a multitude of aircraft applications.

With the advent of the B-52 Bomber, the requirement for a multicrew, multifunctional integrated escape system necessitated that a different type of propellant actuated device, a thruster, be developed to position seats, unlock hatches, stow steering control columns, and perform other pre-ejection functions. Together with the airframe manufacturers and Air Force Frankford Arsenal designed and developed the first in a series of thrusters designated M1, M2, M3, and M5 in 1951.

Over 3200 American pilots have since been saved by using systems which are in whole or in part operated by Frankford Arsenal propellant actuated devices. Also there is no known record of a systems failure as a result of a Frankford Arsenal developed device.

Frankford Arsenal now supplies the Army, Navy, Air Force, National Aeronautical and Space Administration, Canada and many NATO countries with many of the highly reliable propellant actuated devices used in their Aircraft Emergency Escape Systems.

Advancements in the state-of-art of propellant actuated devices achieved at Frankford Arsenal are evidenced by the issuance of some 180 patents to Arsenal Engineers and Scientists.

This manual contains all propellant actuated devices including those that have not reached type classification status (designated by XM-).

Frankford Arsenal is the Army Commodity Center for CAD/PAD and Single Service Procurement Manager for FSC 1377 CAD/PAD. Also, Frankford Arsenal has agreements with the Air Force on Logistic Support (OOAMA) and Research and Development (ASD).

PAD BALLISTICS LABORATORIES

The PAD Ballistics Laboratories are devoted to the mission responsibility of maintaining the state-of-the-art and the entire product life cycle from concept through fielding. The ballistic test and evaluation complex consists of a large variety of special fixtures which permit simultaneity of testing several items ranging in size from squibs to personnel rockets containing 10 lb. of propellant. The fixtures vary to allow for that of static or gas generator type firing thru the type used to simulate "G" fields or opposing constant resistive forces to both vertical and horizontal track-carriage type. Chambers for heating and cooling items under test are also available.

The complex is amply equipped with the latest data acquisition systems and closed circuit TV for viewing tests in progress and tapes for instant TV replay.

The complex occupies over 15,000 sq. ft. of floor space.

The following is a brief resume of some of the equipment:

- a. A 150 ft. vertical tower with tracks and carriages. The carriages are designed for incremental weight increases to 1200 lb. and an acceleration of 30 g's with the maximum weight
- b. Eight complete data acquisition systems with concomitant transducers for measuring thrust, velocity, acceleration, travel, time, pressure, and temperature.
- c. Over forty-five special fixtures for ballistic testing of items containing up to 10 lb. of propellant. These fixtures provide opposing masses and forces, static ballistic testing, temperature conditioning, hi-vacuum, dynamic, and static testing of seals.
- d. A 125 ft. vertical tower with tracks and carriages used to simulate various masses which PAD must accelerate.

TECHNICAL CONSULTING SERVICES

Frankford Arsenal provides technical assistance and consulting in the field of PAD and Ordnance Engineering to other Government Agencies and their Contractors.

To mention a few, in the past, Frankford Arsenal engineers and scientists have provided such consulting services to U.S. Air Force ASD, BSD (AVCO and General Electric), Atomic Energy Commission (Sandia Base), AVCOM, & NLABS.

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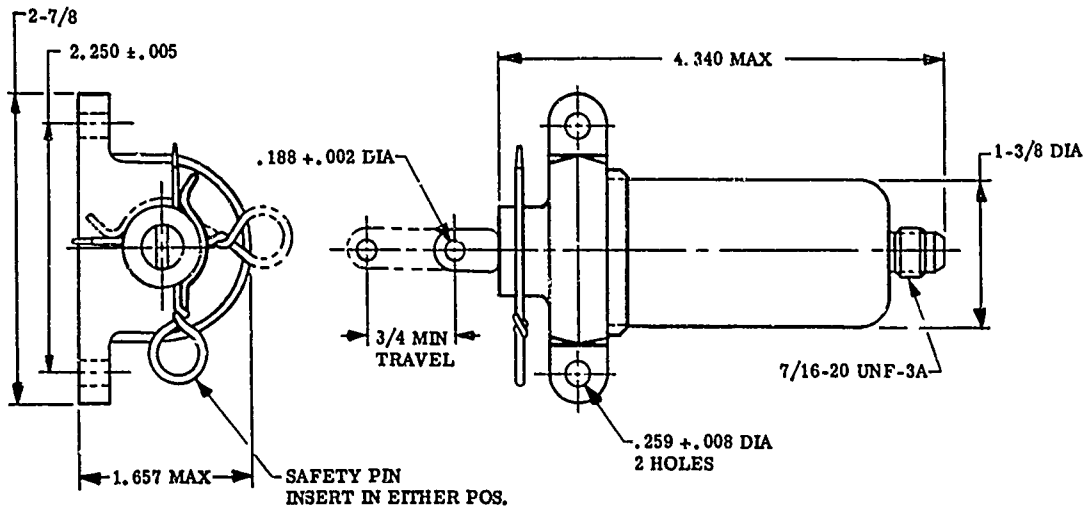
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INITIATORS

Initiators are designed primarily to supply gas pressure to operate firing mechanisms of other propellant actuated devices, and they may also be used as sources of energy to operate piston devices such as safety-belt releases and safety pin extractors. All initiators were developed to contain the gas pressure, that is to function at "locked-shut" condition.

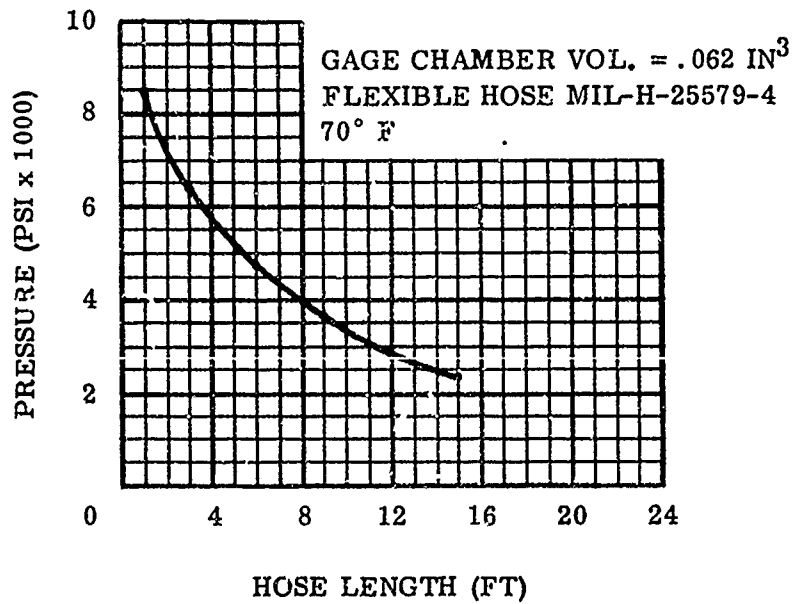
INITIATOR, CARTRIDGE ACTUATED, M3A1C



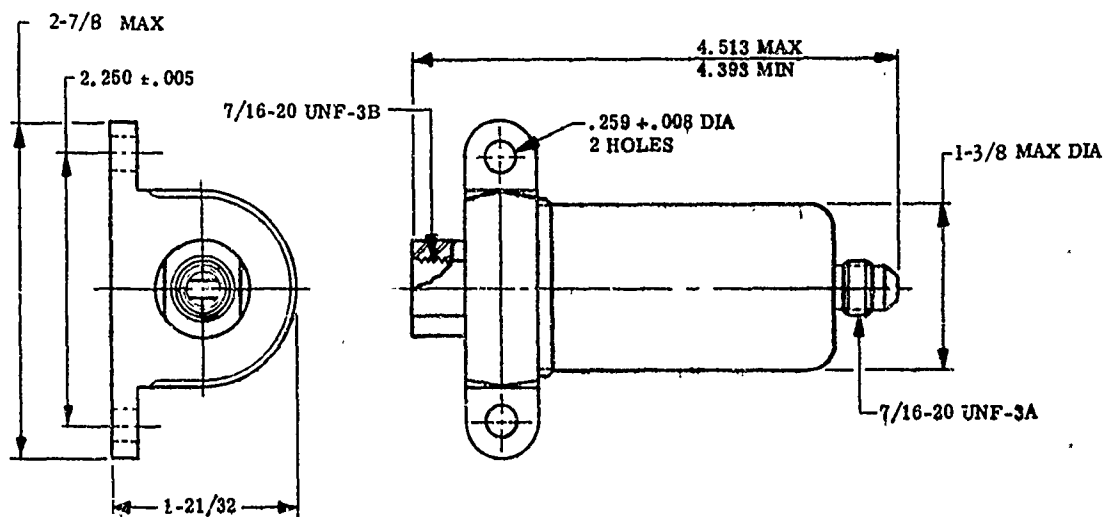
DATA

1. Weight of Assembly 0.9 lb.
2. Actuation Method Mechanical
3. Actuation Force. 40 lbs.
4. Operating Temperature Limits. -65° F to $+200^{\circ} \text{ F}$

TYPICAL PERFORMANCE



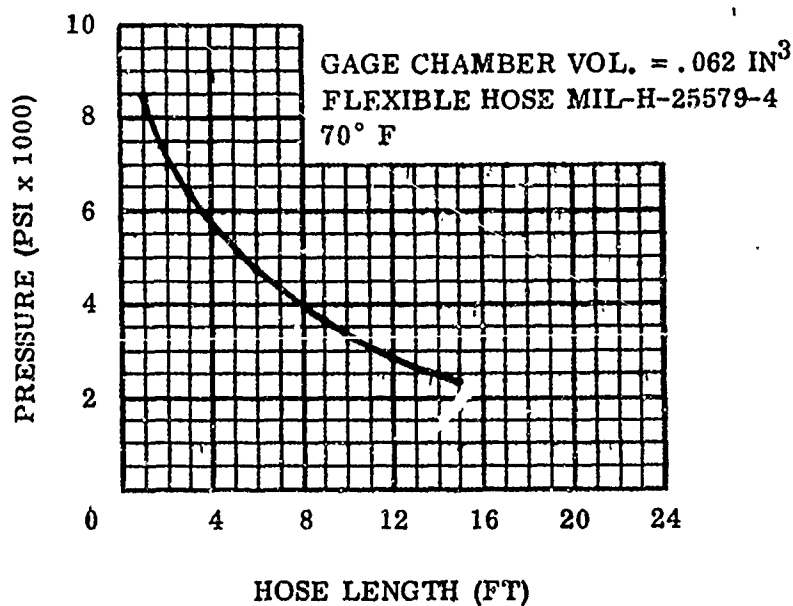
INITIATOR, CARTRIDGE ACTUATED, M5A2



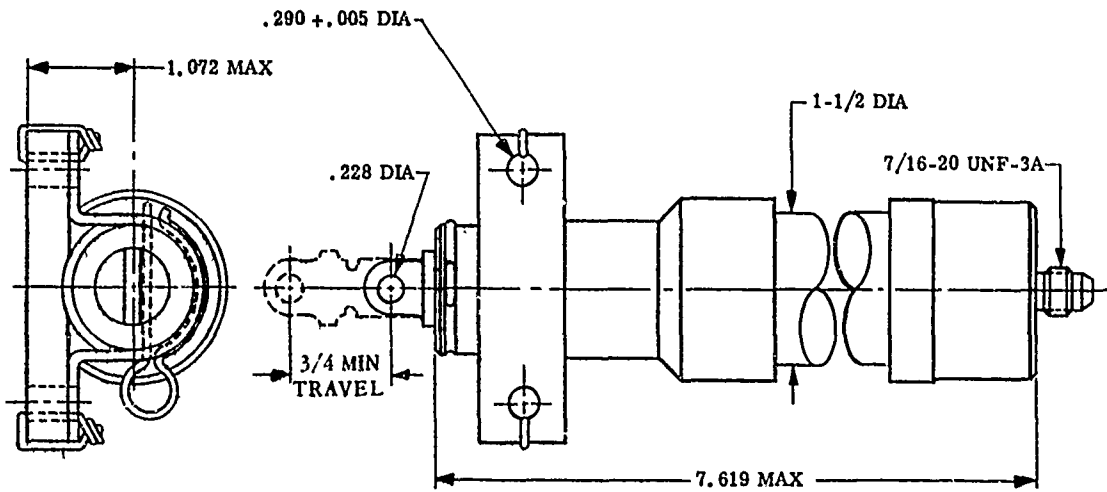
DATA

1. Weight of Assembly 0.9 lb.
2. Actuation Method Gas
3. Actuation Pressure 1000 psi (minimum)
4. Operating Temperature Limits -65° F. to +200° F.

TYPICAL PERFORMANCE



INITIATOR, CARTRIDGE ACTUATED, M8



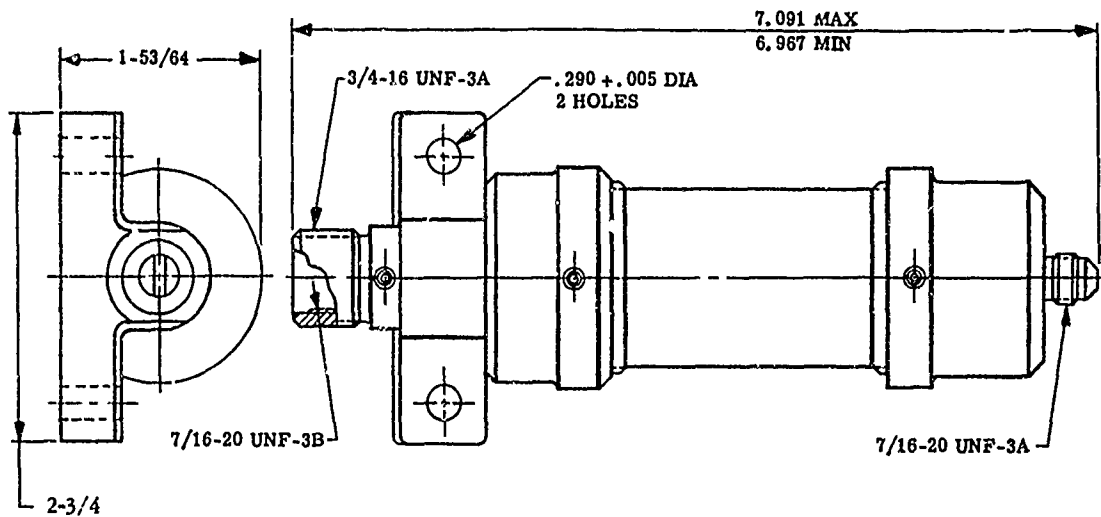
DATA

- | | |
|---|-----------------|
| 1. Weight of Assembly | 3.2 lbs. |
| 2. Actuation Method | Mechanical |
| 3. Actuation Force. | 40 lbs. |
| 4. Operating Temperature Limits | -65°F to +200°F |

TYPICAL PERFORMANCE

The M8 initiator will deliver a peak pressure of 1000 psi (-65°F) to 3000 psi (200°F) at the end of a 30-foot flexible hose (MS28741-4)

INITIATOR, CARTRIDGE ACTUATED, M9



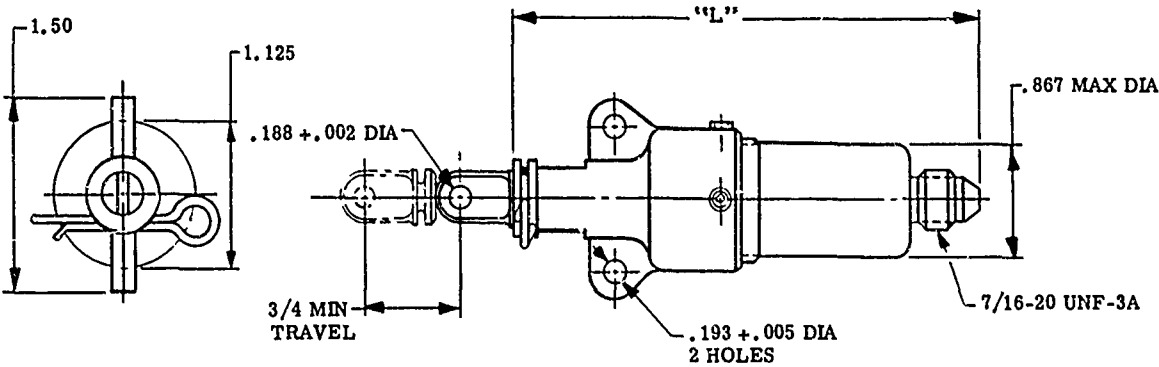
DATA

- | | |
|---|---|
| 1. Weight of Assembly | 3.2 lb. |
| 2. Actuation Method | Gas |
| 3. Actuation Pressure | 1000 psi (minimum) |
| 4. Operating Temperature Limits | -65°F to $+200^{\circ}\text{F}$ |

TYPICAL PERFORMANCE

The M9 initiator will deliver a peak pressure of 1000 psi (-65°F) to 3000 psi (200°F) at the end of a 30-foot flexible hose (MS28741-4).

INITIATOR, CARTRIDGE ACTUATED, DELAY (Miniature Type)



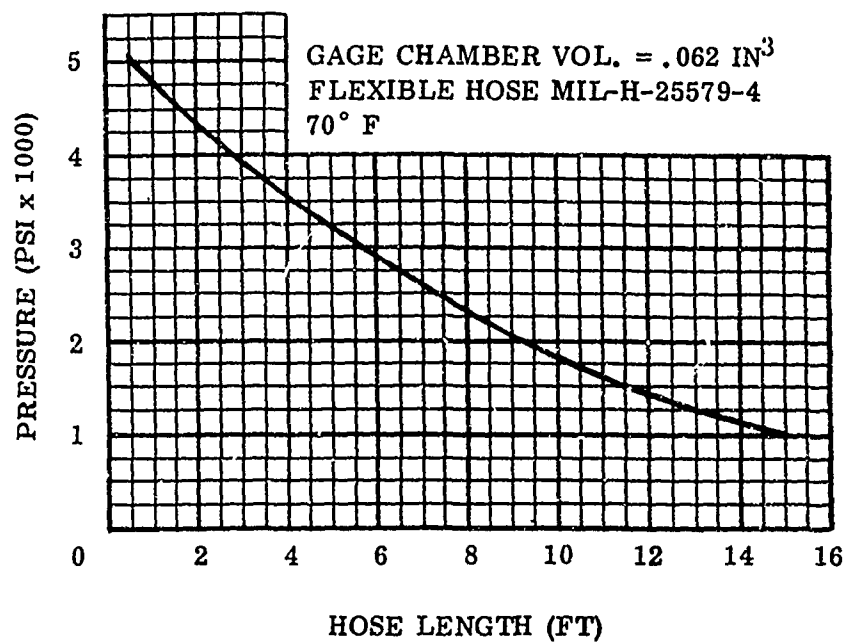
DESIGNATION	DIMENSION "L" (Max.)	TYPICAL PERFORMANCE GRAPH	DELAY TIME (seconds)
M14	5.2825	A	3
M16	5.2825	B	3
M54	5.2825	B	5
M89	5.167	B	5

DATA

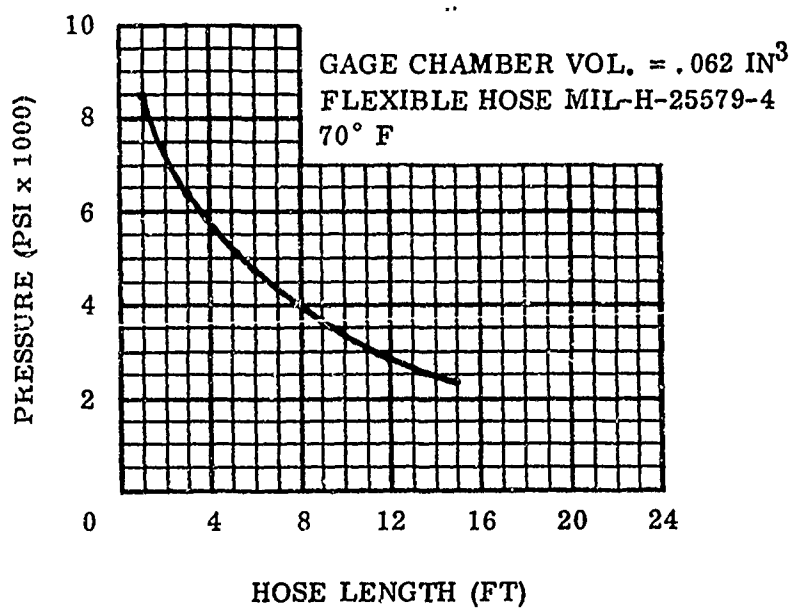
1. Weight of Assembly 0.33 lb.
2. Actuation Method Mechanical
3. Actuation Force 40 lbs.
4. Operating Temperature Limits -65° F to +200°F

INITIATOR, CARTRIDGE ACTUATED, DELAY (Cont'd.)
M14, M16, M54, And M89
(Miniature Type)

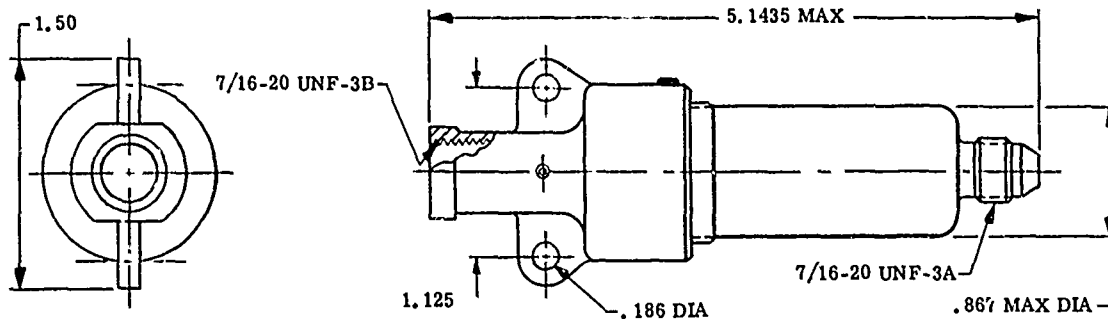
TYPICAL PERFORMANCE (GRAPH A)



TYPICAL PERFORMANCE (GRAPH B)



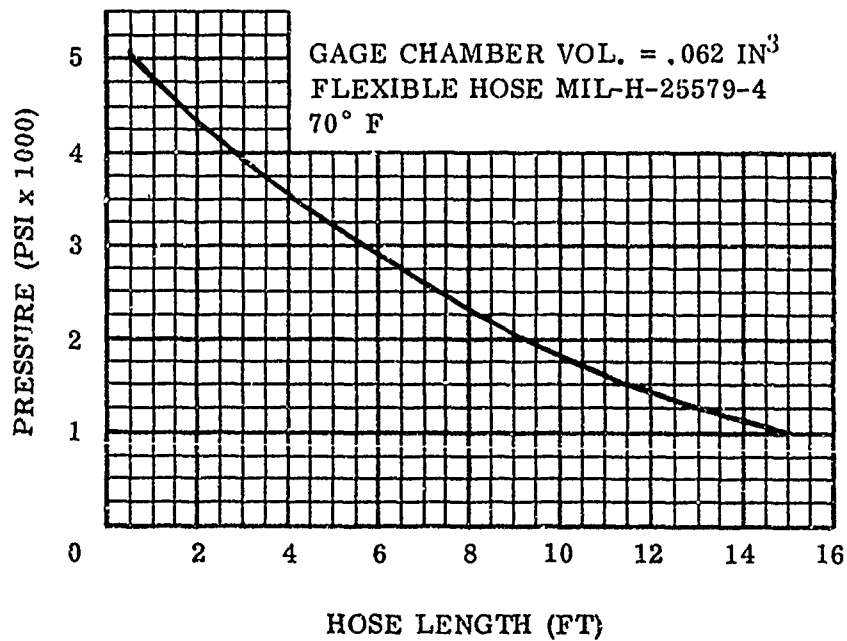
INITIATOR, CARTRIDGE ACTUATED, DELAY, M15 (Miniature Type)



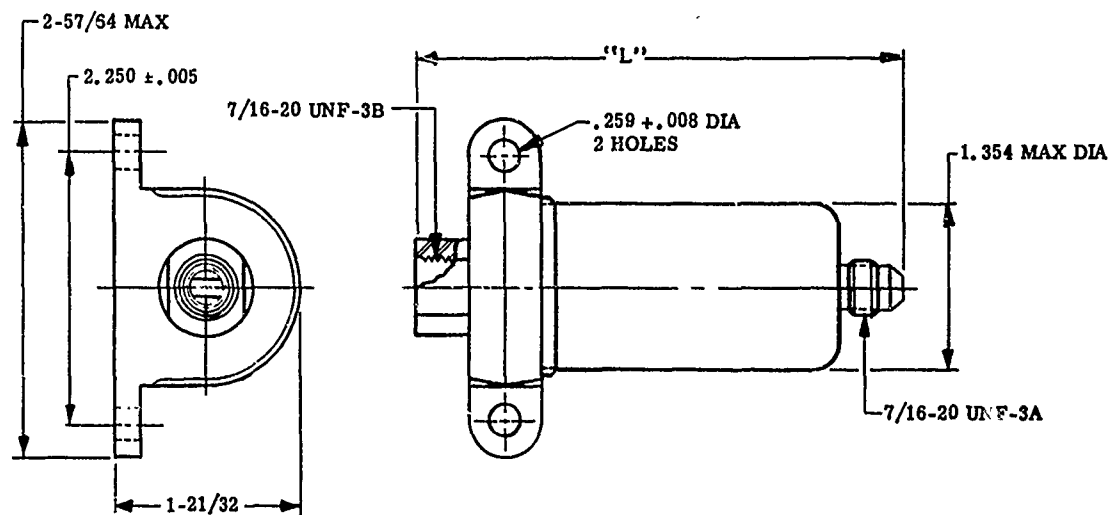
DATA

1. Weight of Assembly 0.39 lb.
2. Actuation Method Gas
3. Actuation Pressure 1000 psi.(minimum)
4. Operating Temperature Limits. -65°F to +200°F
5. Delay Time 3 sec.

TYPICAL PERFORMANCE



INITIATOR, CARTRIDGE ACTUATED, DELAY



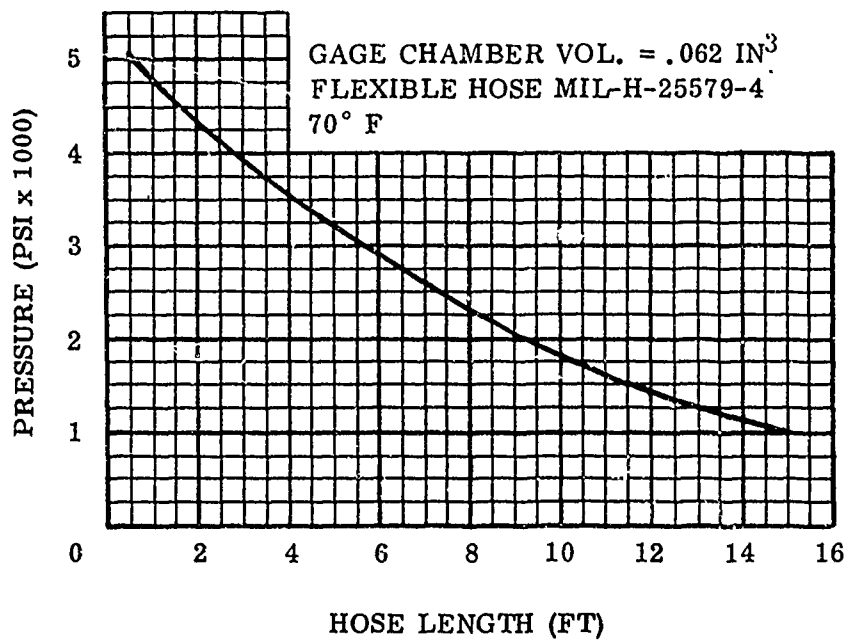
DESIGNATION	DIMENSION "L"		TYPICAL PERFORMANCE GRAPH	DELAY TIME (seconds)
	Max.	Min.		
M6A1	5.206	5.090	A	2
M10	5.491	5.375	B	2
M26	5.206	5.090	A	0.3
M31	5.491	5.357	B	1
M33	5.206	5.090	A	1
M42	5.491	5.375	B	3
M44	5.206	5.090	A	3

DATA

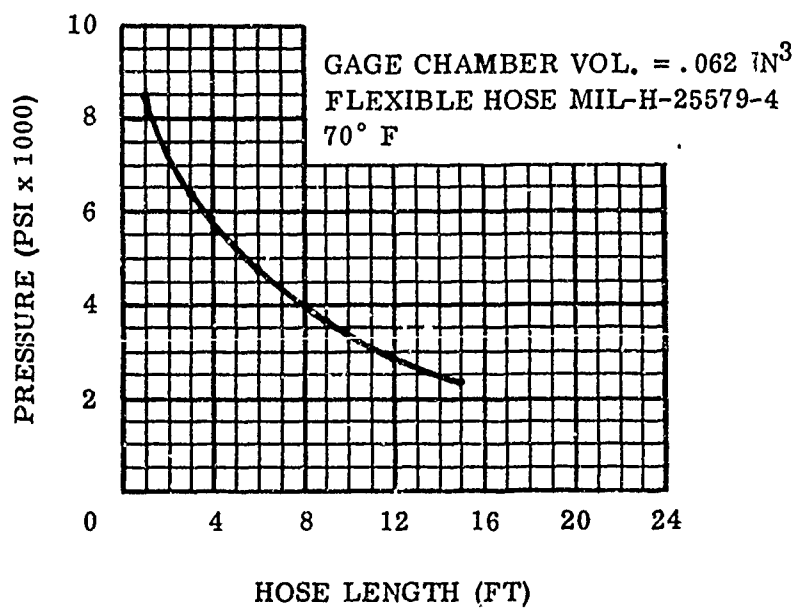
- 1. Weight of Assembly 0.9 lb.
- 2. Actuation Method Gas
- 3. Actuation Pressure 1000 psi.(minimum)
- 4. Operating Temperature Limits -63° F to +200° F

INITIATOR, CARTRIDGE ACTUATED, DELAY (Cont'd.)
M6A1, M10, M25, M31, M33, M42, And M44

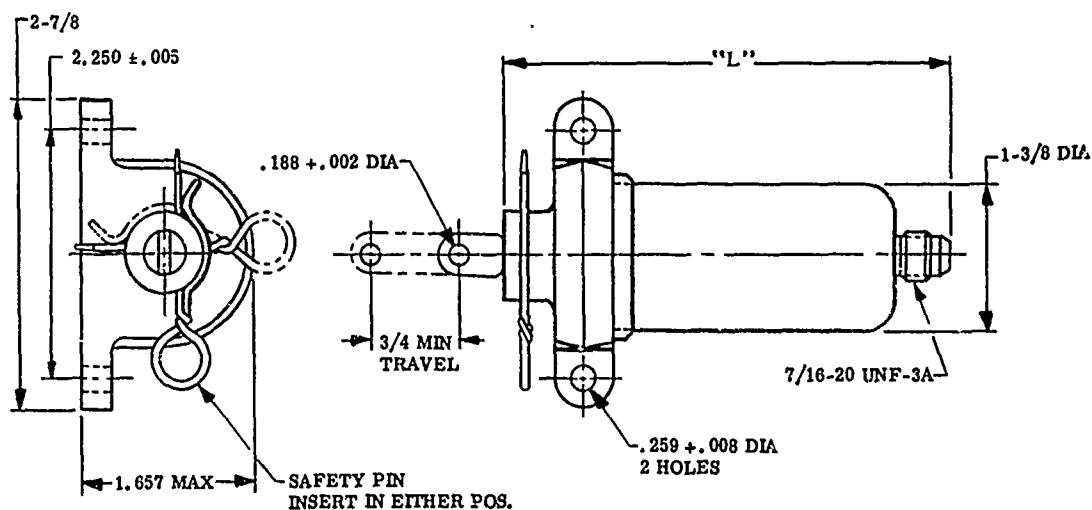
TYPICAL PERFORMANCE (GRAPH A)



TYPICAL PERFORMANCE (GRAPH B)



INITIATOR, CARTRIDGE ACTUATED, DELAY



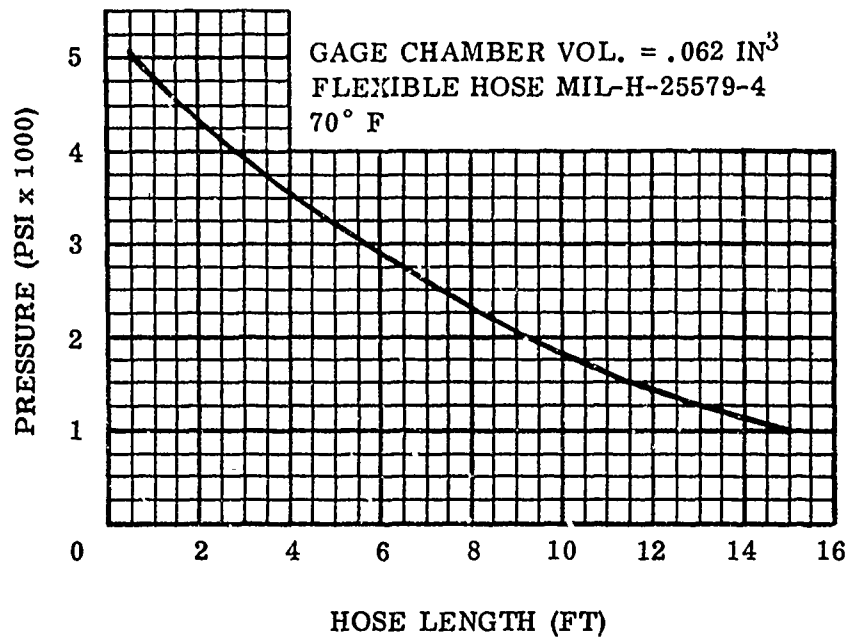
DESIGNATION	DIMENSION "L"	TYPICAL PERFORMANCE GRAPH	DELAY TIME (seconds)
M4	5.03 Max. 4.89 Min.	A	2
M12A1	5.03 Max. 4.89 Min.	A	1
M30A1	5.320 Max. 5.180 Min.	B	2
M32A1	5.320 Max. 5.180 Min.	B	1
M43A1	5.320 Max. 5.180 Min.	B	3
M45A1	5.03 Max. 4.89 Min.	A	3
M49A1	5.03 Max. 4.89 Min.	A	0.3

DATA

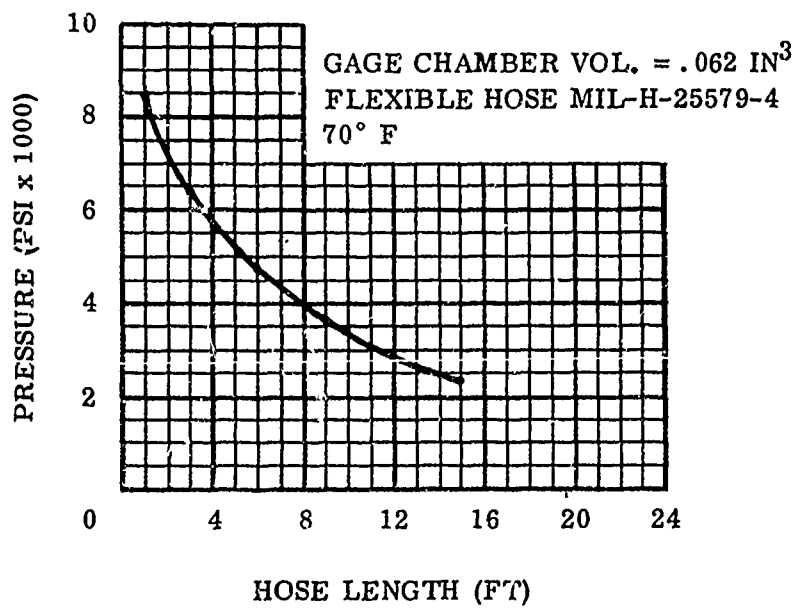
1. Weight of Assembly 1.0 lb.
2. Actuation Method Mechanical
3. Actuation Force 40 lbs. (minimum)
4. Operating Temperature Limit -65°F to +200°F

INITIATOR, CARTRIDGE ACTUATED, DELAY (Cont'd.)
M4, M12A1, M30A1, M32A1, M43A1, M45A1, And M49A1

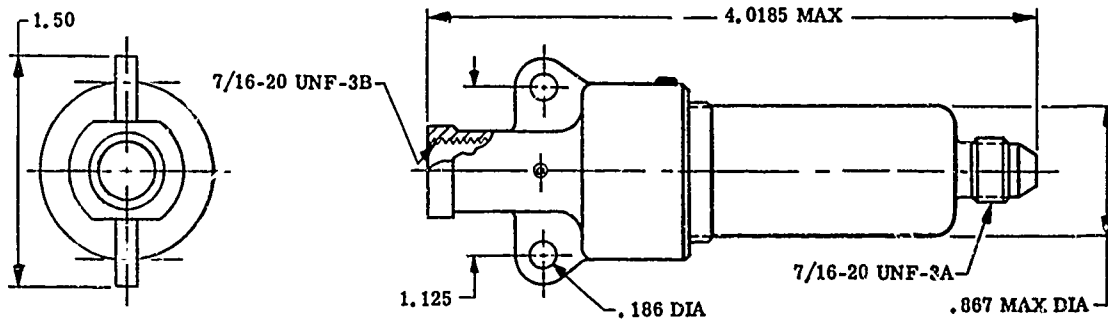
TYPICAL PERFORMANCE (GRAPH A)



TYPICAL PERFORMANCE (GRAPH B)



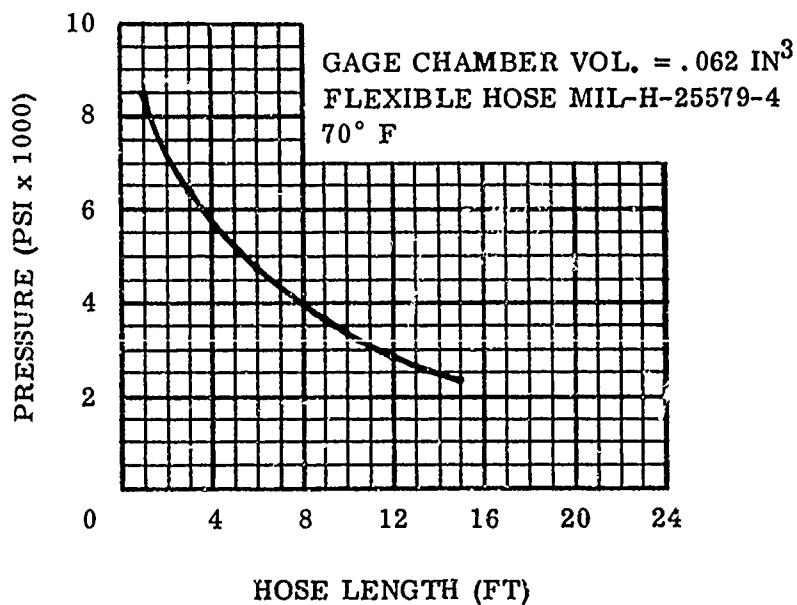
INITIATOR, CARTRIDGE ACTUATED, M28 (Miniature Type)



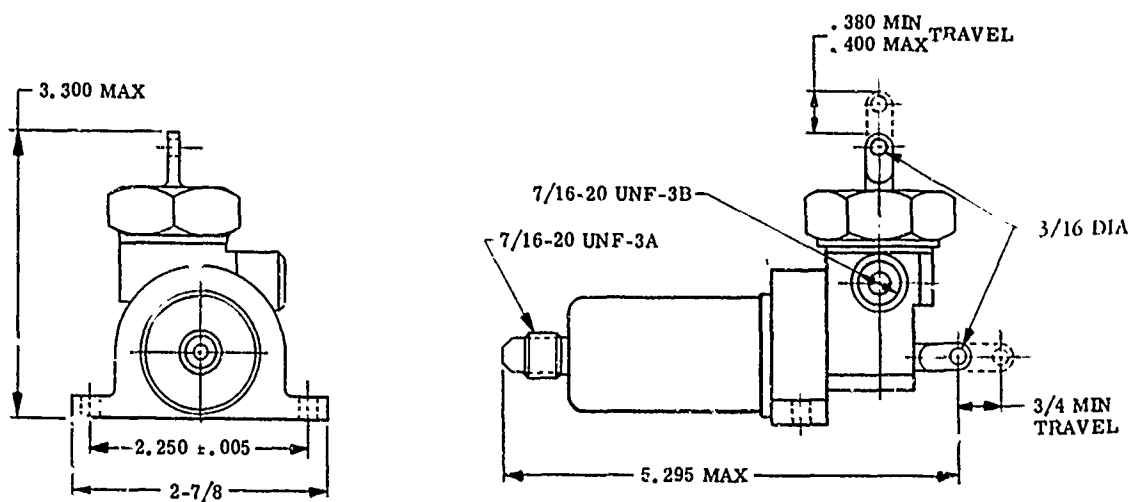
DATA

1. Weight of Assembly 0.3 lb.
2. Actuation Method Gas
3. Actuation Pressure 1000 psi (minimum)
4. Operating Temperature Limits -65°F to +200°F

TYPICAL PERFORMANCE



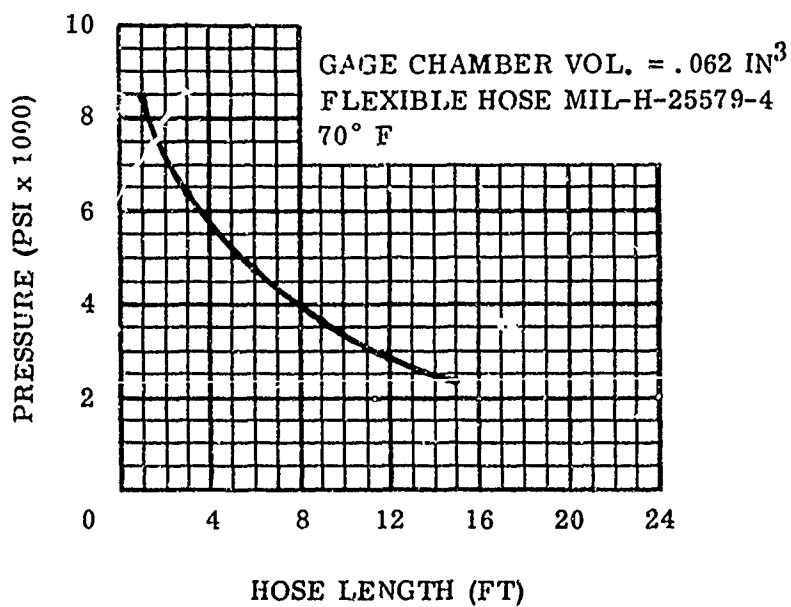
INITIATOR, CARTRIDGE ACTUATED, M29



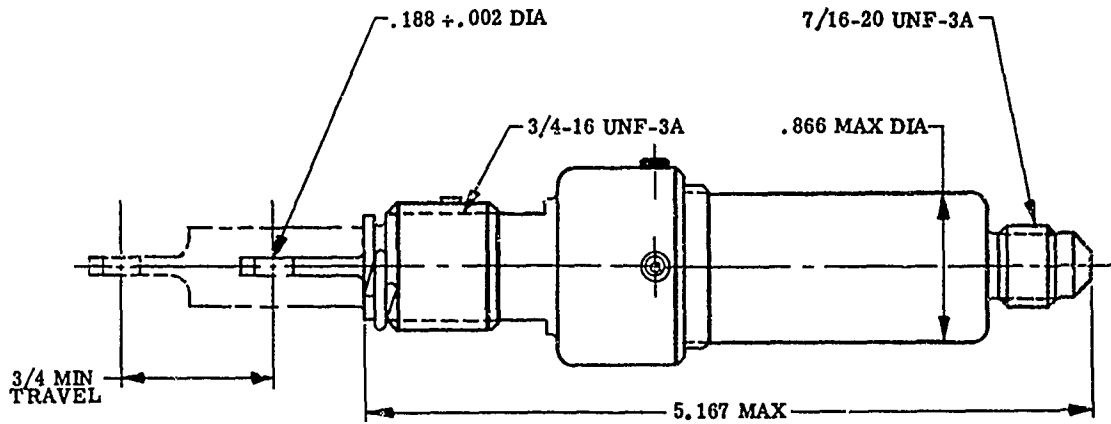
DATA

1. Weight of Assembly 1.75 lbs.
2. Actuation Method Gas w/Manual Override
3. Actuation:
 - Pressure 1000 psi (minimum)
 - Force, Manual Override 25 lbs.
 - Initiator Pin Preload 40 lbs.
4. Operating Temperature Limit -65°F to +200°F

TYPICAL PERFORMANCE



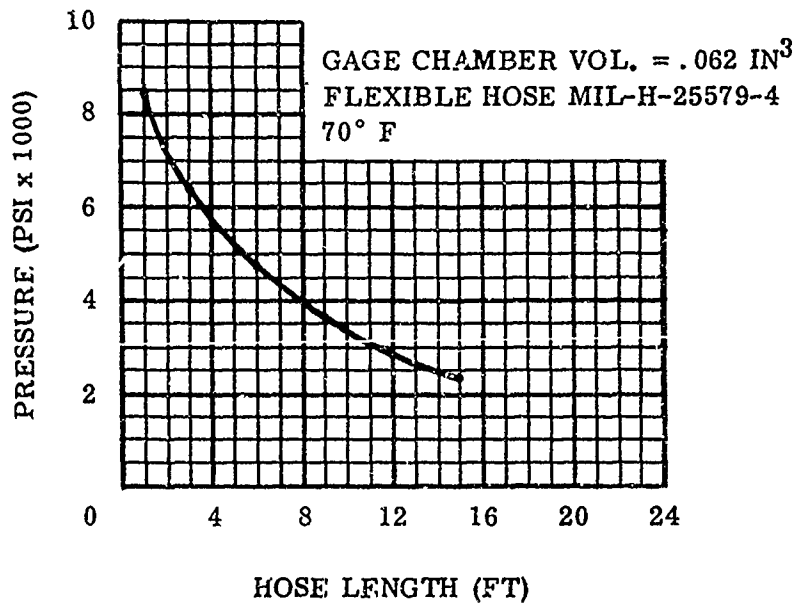
INITIATOR, CARTRIDGE ACTUATED, DELAY, M52 (Miniature Type)



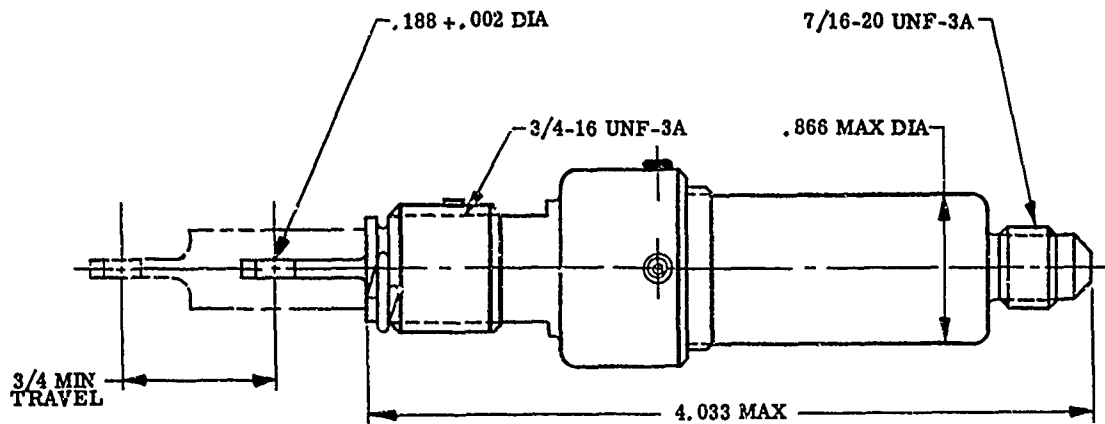
DATA

1. Weight of Assembly 0.39 lb.
2. Actuation Method Mechanical
3. Actuation Force 40 lbs.
4. Operating Temperature Limits -65°F to +200°F
5. Delay Time 5 sec.

TYPICAL PERFORMANCE



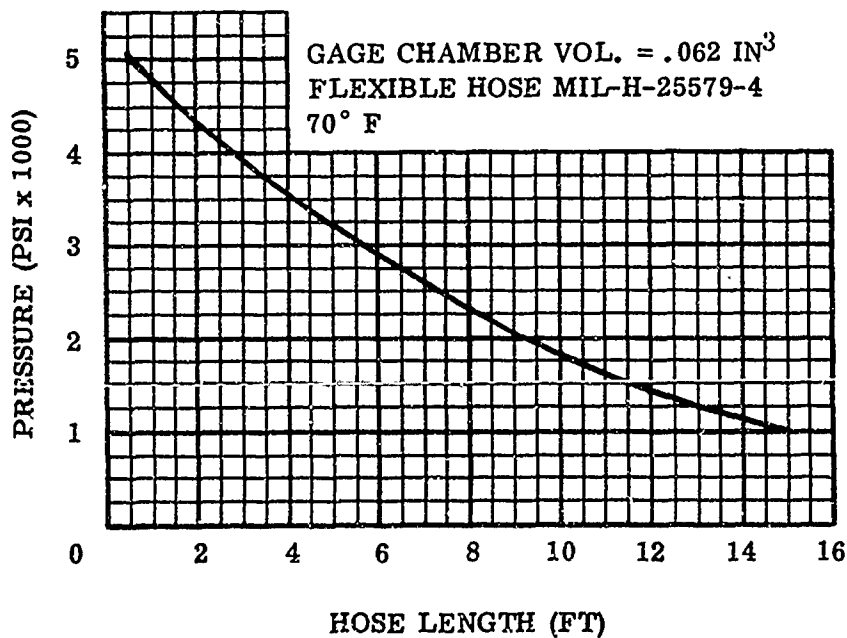
INITIATOR, CARTRIDGE ACTUATED, M86 (Miniature Type)



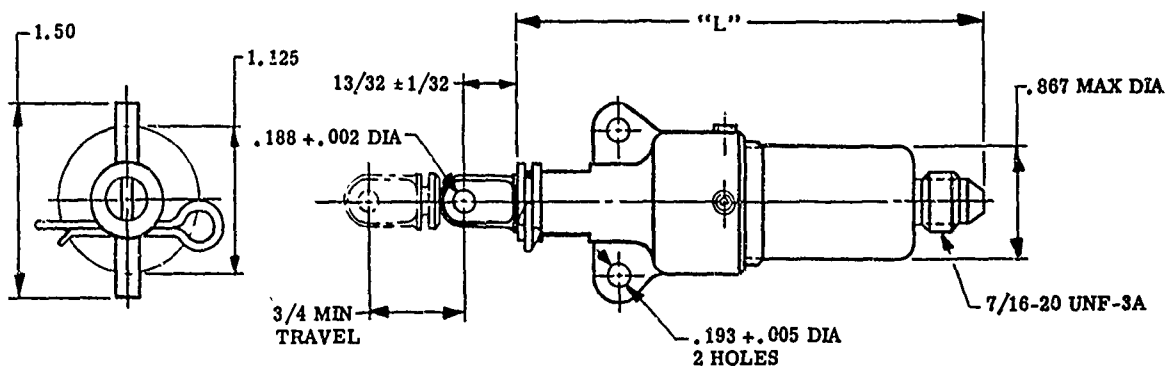
DATA

1. Weight of Assembly 0.3 lb.
2. Actuation Method Mechanical
3. Actuation Force 40 lbs.
4. Operating Temperature Limits -65° F. to +200° F.

TYPICAL PERFORMANCE



INITIATOR, CARTRIDGE ACTUATED (Miniature Type, Non-Delay)

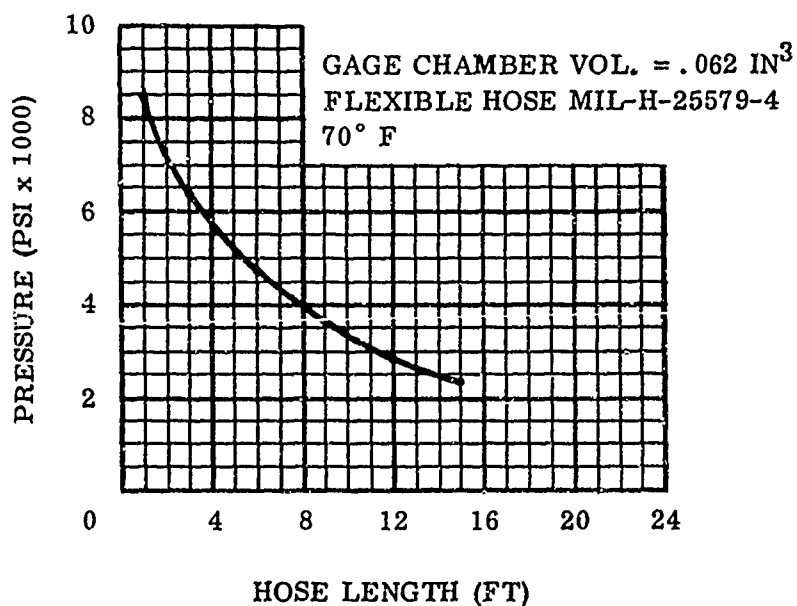


DESIGNATION	DIMENSION "L" (Max.)	TYPICAL PERFORMANCE GRAPH
M27	4.1575	B
M87	4.033	B

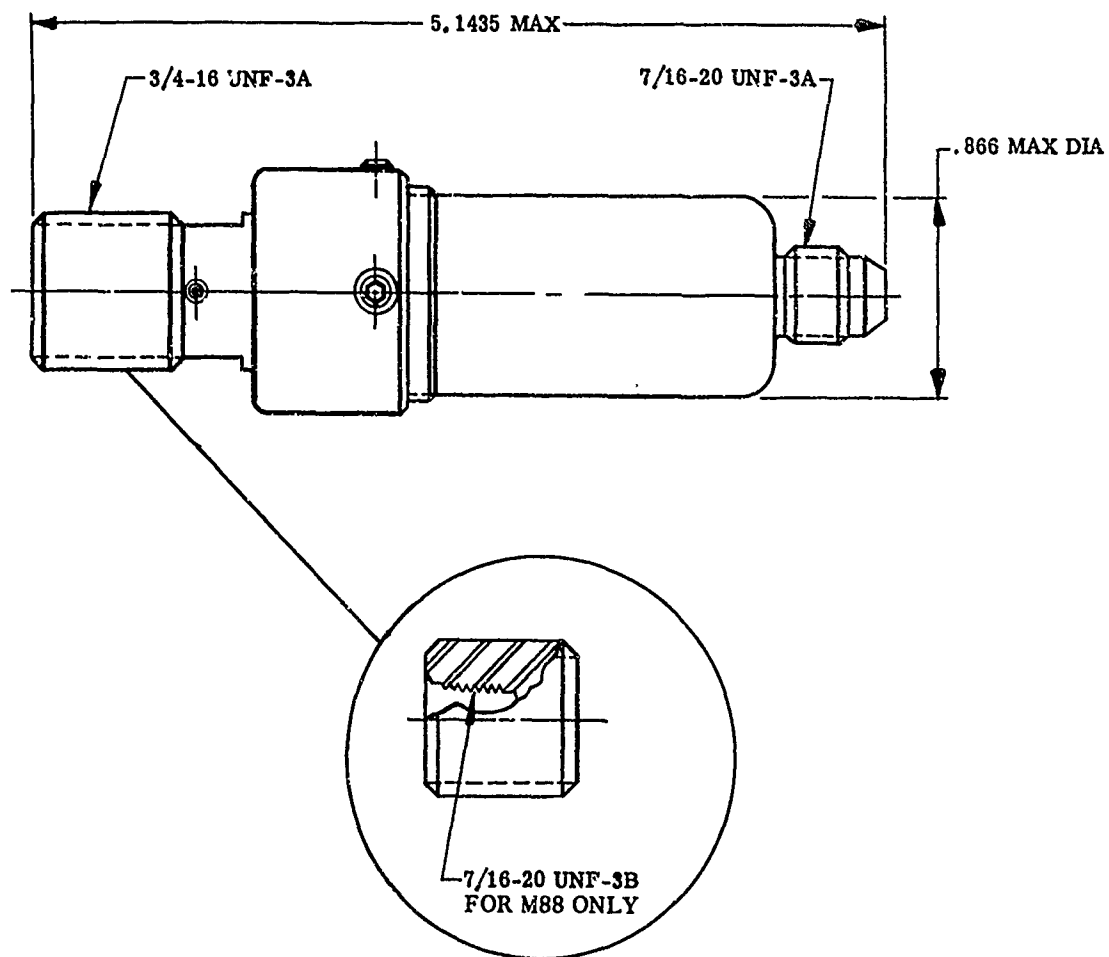
DATA

1. Weight of Assembly 0.33 lbs.
2. Actuation Method Mechanical
3. Actuation Force 40 lbs.
4. Operating Temperature Limits -65°F to +200°F

TYPICAL PERFORMANCE



INITIATOR, CARTRIDGE ACTUATED, DELAY, M51, M88
(Miniature Type)

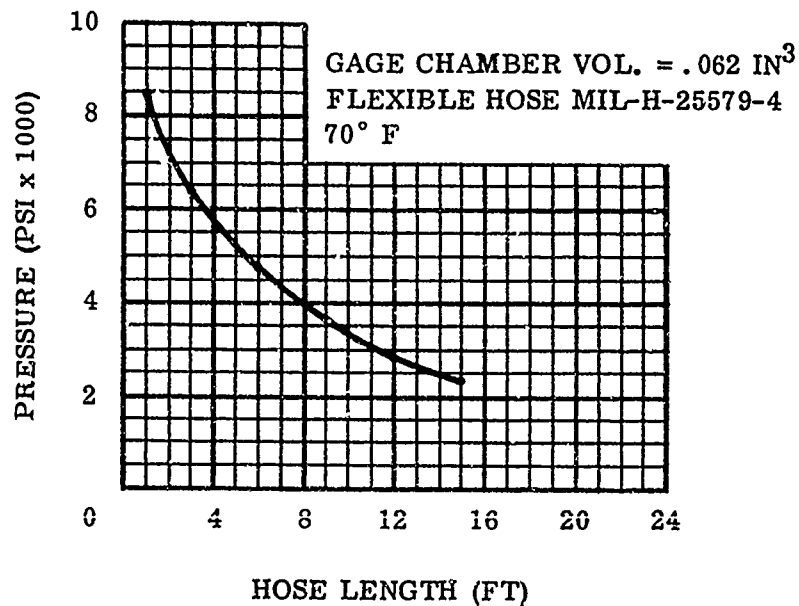


INITIATOR, CARTRIDGE ACTUATED, DELAY, M51 and M88 (Cont'd) (Miniature Type)

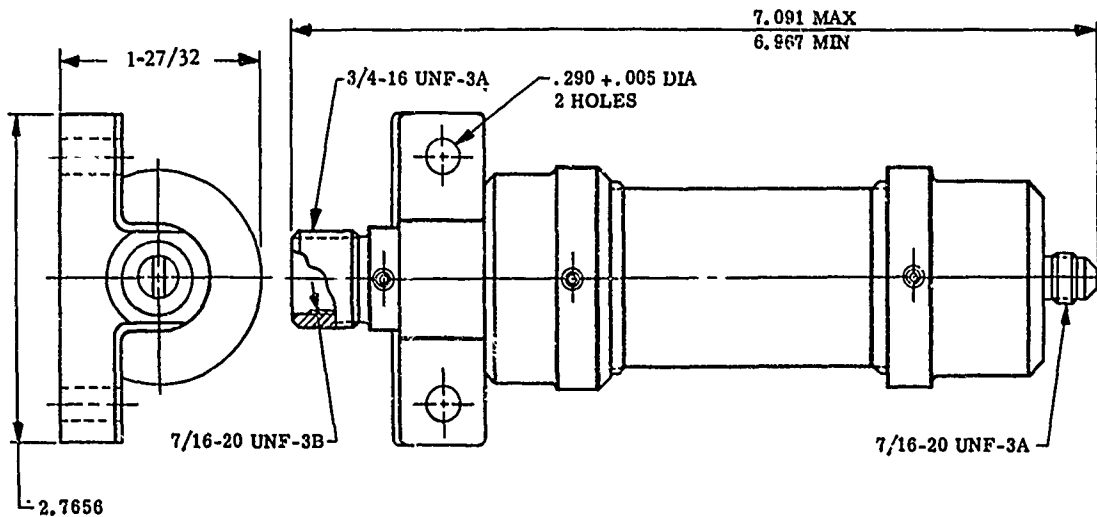
DATA

1. Weight of Assembly 0.39 lb.
2. Actuation Method Gas
3. Actuation Pressure 1000 psi (minimum)
4. Operating Temperature Limits -65° F to +200° F
5. Delay Time 2 sec.

TYPICAL PERFORMANCE



INITIATOR, CARTRIDGE ACTUATED, M80



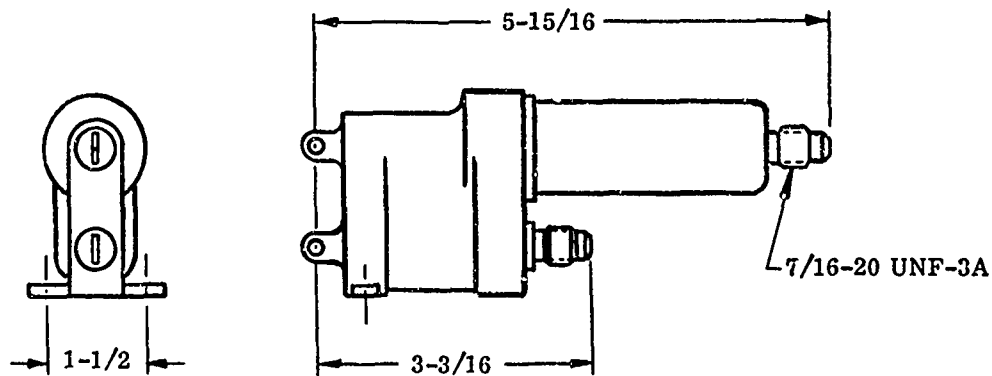
DATA

1. Weight of Assembly 3.2 lbs.
2. Actuation Method Gas
3. Actuation Pressure 1000 psi (minimum)
4. Operating Temperature Limits -65°F to +200°F
5. The M80 initiator is a sealed M9 type initiator which restricts Toxic gas leakage to prevent atmospheric contamination.

TYPICAL PERFORMANCE

In the temperature range of -65° to +160°F the M80 initiator will deliver a peak pressure of 1000 to 3000 psi at the end of a 30-foot flexible hose (MS28741-4).

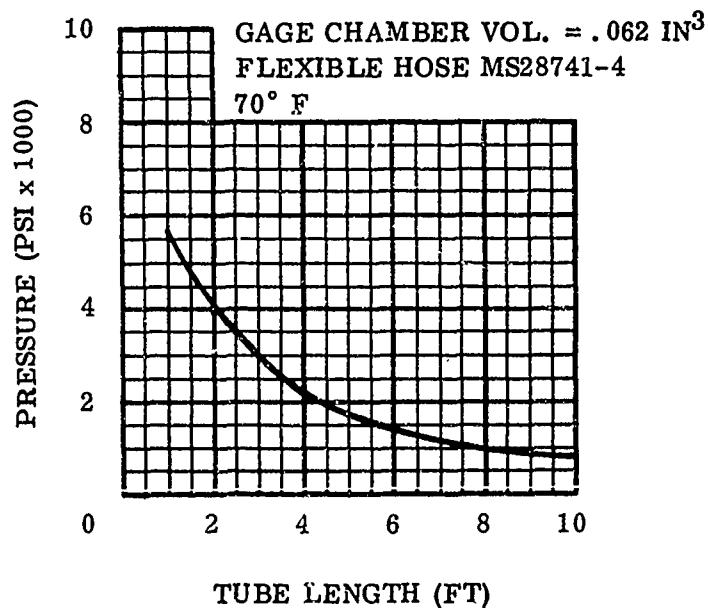
INITIATOR, CARTRIDGE ACTUATED DELAY, XM-90



DATA

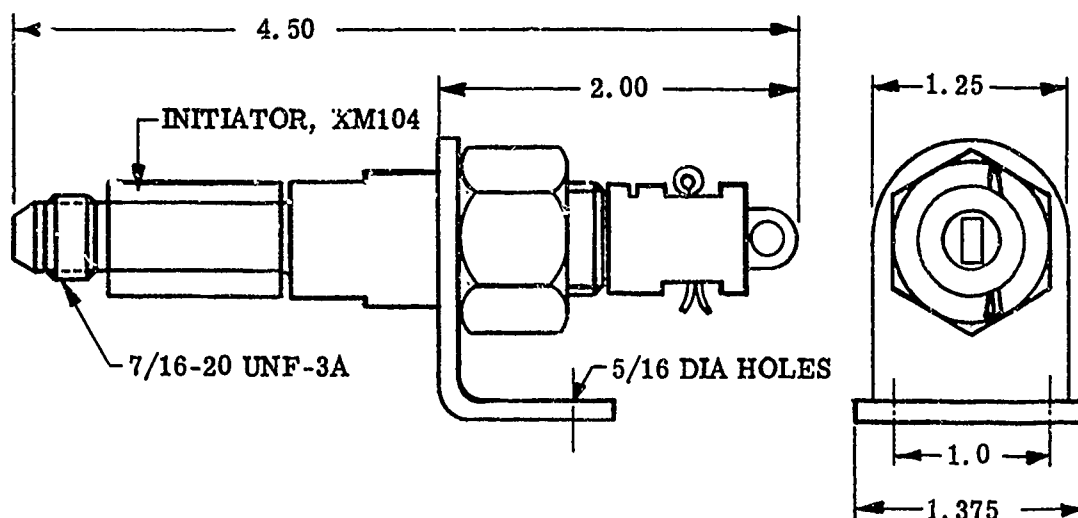
1. Weight of Assembly	0.56 lb.
2. Operating Temperature Limits.	-65° F. to +200° F.
3. Firing Method	Mechanical
4. Actuation Force	20 to 30 lbs.
5. Force of Manual Override	15 lbs. (maximum)
6. Time Delay	0.3 sec.

TYPICAL PERFORMANCE



This miniaturized (saving in weight and space) initiator is a device designed to supply gas pressure to operate the firing mechanism of other cartridge actuated devices. It incorporates an integral extractor with a manual override, in case of malfunction of the gas operated mechanism.

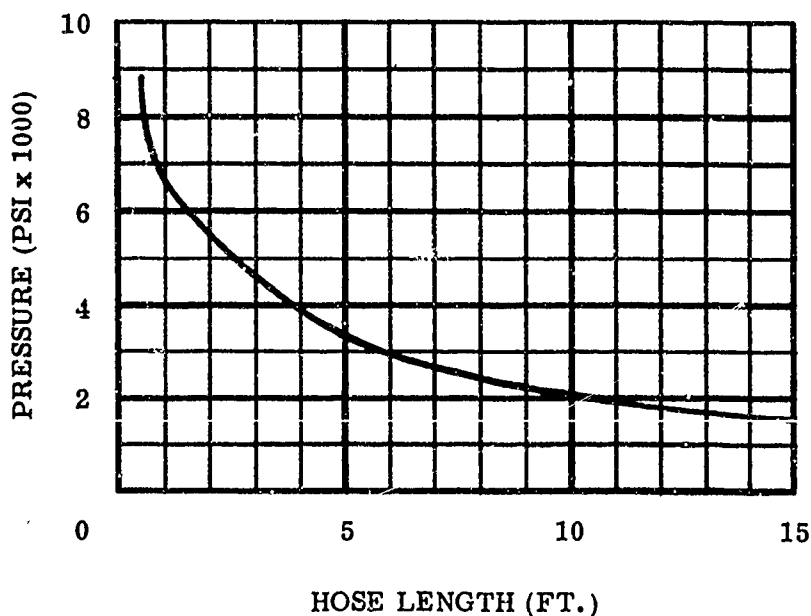
INITIATOR, CARTRIDGE ACTUATED, XM111



DATA

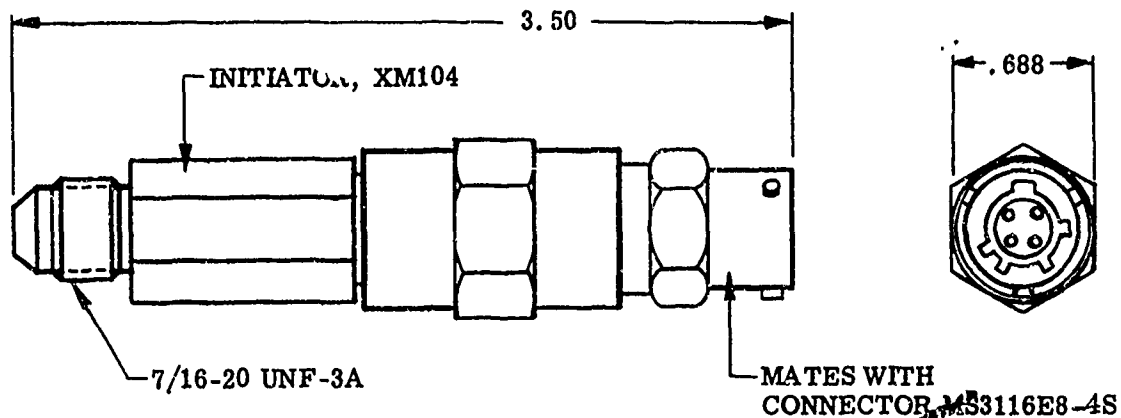
1. Weight of Assembly 4.0 Ounces
2. Actuation Force 17 to 25 Pounds Pull
3. Operating Temperature Limits -65 to +200°F

TYPICAL PERFORMANCE



This sub-miniature initiator is for use in mechanically actuated pad systems requiring gas pressure at the end of specific lengths of AN-4 hose. The initiator is designed for bracket or bulkhead mounting (Bracket Mounting Illustrated).

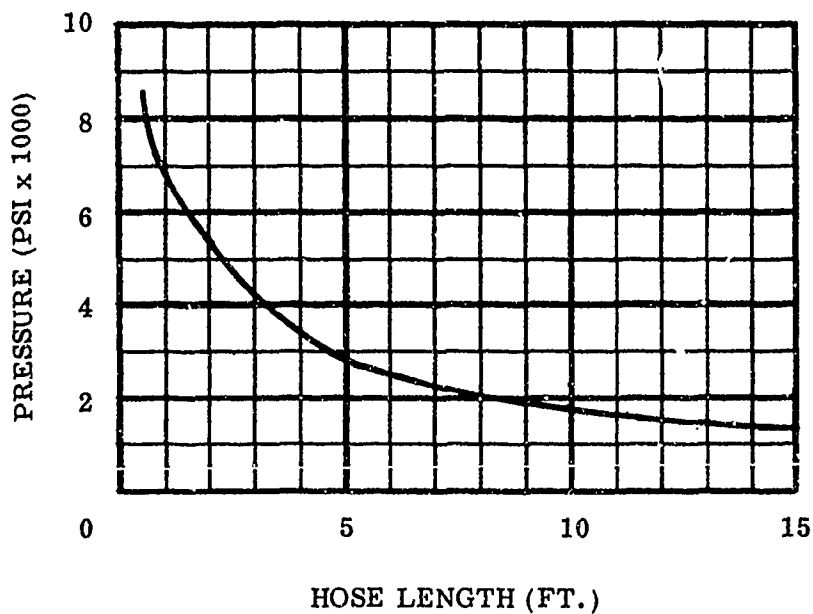
INITIATOR, PROPELLANT ACTUATED, XM112



DATA

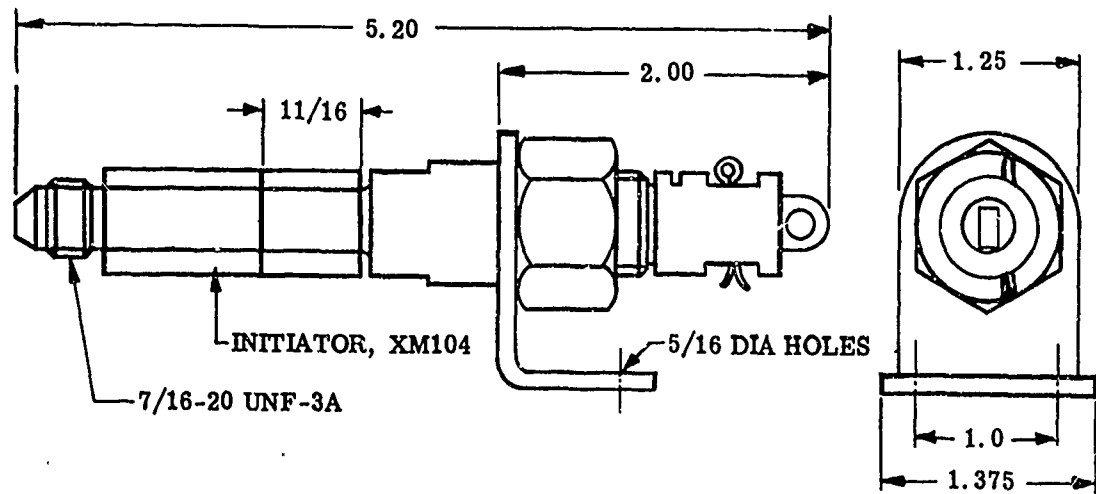
1. Weight of Assembly 3.3 Ounces
2. No Fire 1.0 Amp/1.0 Watt, 5 min.
3. Recommended Firing Current 5.0 Amp.
4. Operating Temperature Limits. -65°F. to +200°F.

TYPICAL PERFORMANCE



This sub-miniature initiator is for use in electrically actuated pad systems requiring gas pressure at the end of various lengths of AN-4 hose. The initiator is held in position by a hold clamp. (Not shown).

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM113

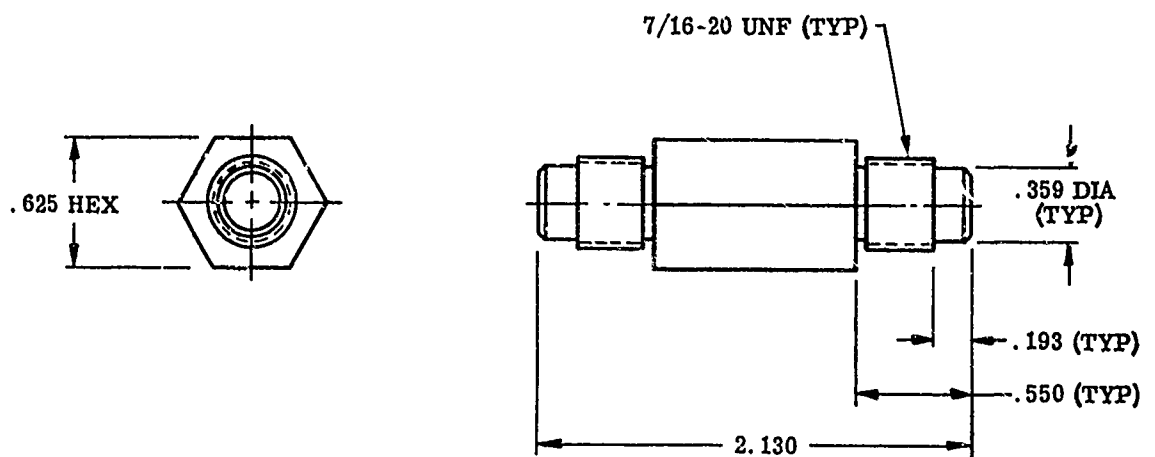


DATA

- | | |
|-------------------------------------|--|
| 1. Weight. | 1/2 Ounce |
| 2. Delay Time(s) | Can be supplied in
0.3, 0.5, 0.7, 1.0, 1.5,
2.0 Sec. |
| 3. Operating Temp. Limits | -65 to 200°F |

This sub-miniature initiator is used in combination with the X111 Initiator firing head and the XM104 Initiator. The XM113 Initiator is used as a replacement for delay initiation where the hose length does not exceed 15 feet in length.

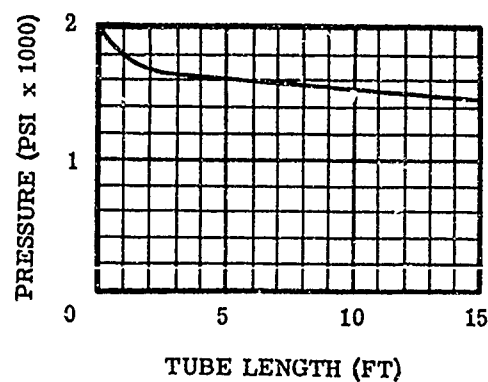
INITIATOR, CARTRIDGE ACTUATED, M-104 (SUB-MINIATURE)



DATA

1. Weight of Assembly 400 grams
2. Operating Temperature Limits $-65^{\circ}\text{F. to } +200^{\circ}\text{F.}$

TYPICAL PERFORMANCE

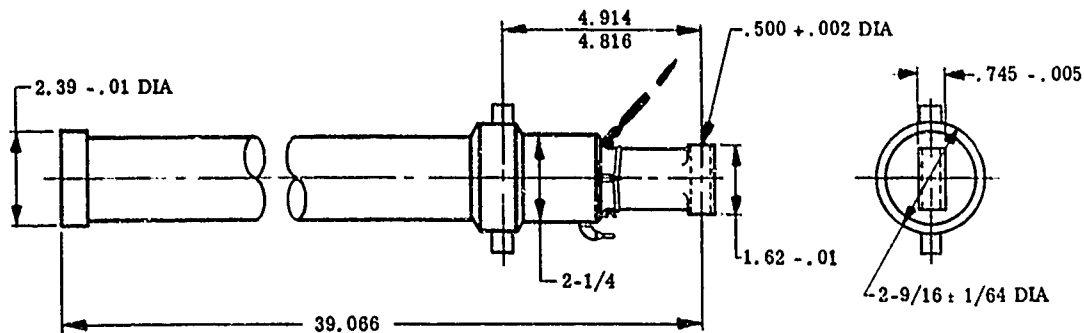


This initiator is installed in a hose line to act as a pressure booster and is an expendable gas initiator, reduced in size, simpler in construction, and more economical to produce than those presently used in aircraft escape systems.

CATAPULTS

The catapult is a propellant actuated device developed for emergency ejection of a seat-man combination from high speed aircraft. Rocket-assisted catapults sustain thrust to increase ejection height without exceeding personnel acceleration maximums.

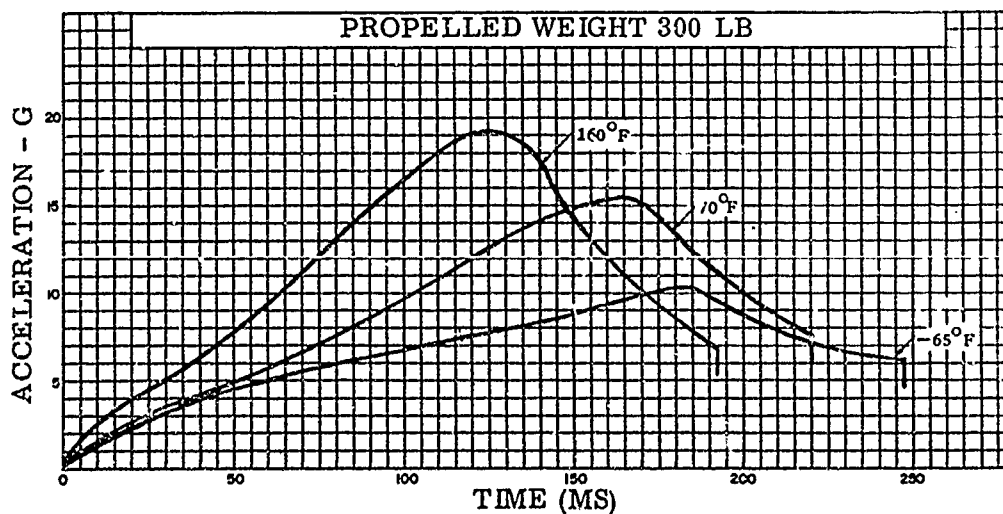
CATAPULT, AIRCRAFT EJECTION SEAT, M1A1



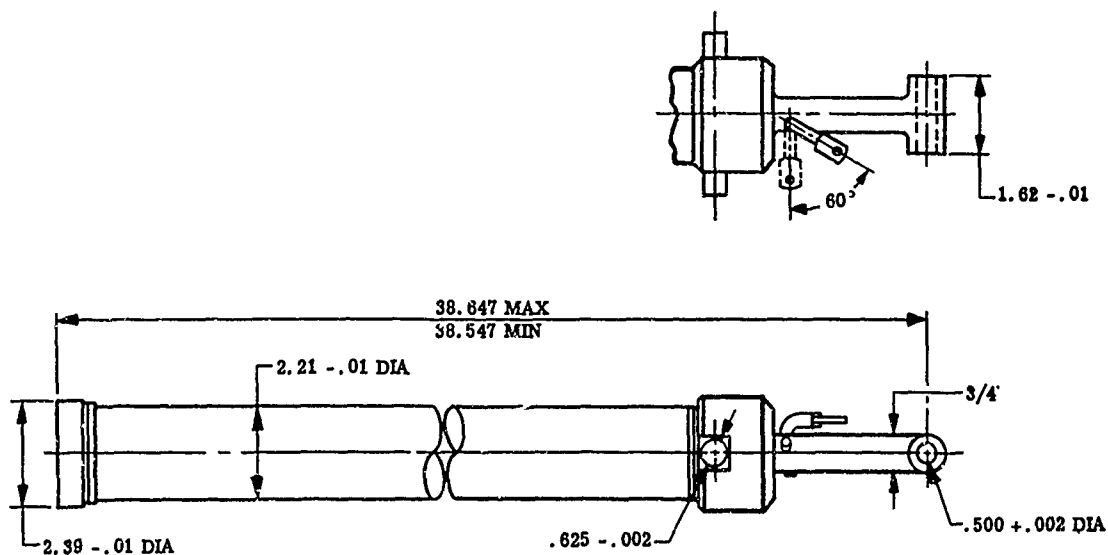
DATA

1. Stroke 66.0 in.
2. Weight (total assembly) 8.2 lbs.
3. Propelled Weight 300.0 lbs.
4. Temperature Limits -65°F to +160°F
5. Max Acceleration (at 70°F) 20.0 g.
6. Velocity, min (at 70°F) 60.0 fps.
7. Max. Rate of Change of Acceleration (at 70°F) 170.0 g/sec.
8. Firing method Mechanical Actuation
9. Stroke Time (at 70°F) 0.220 sec.

TYPICAL PERFORMANCE



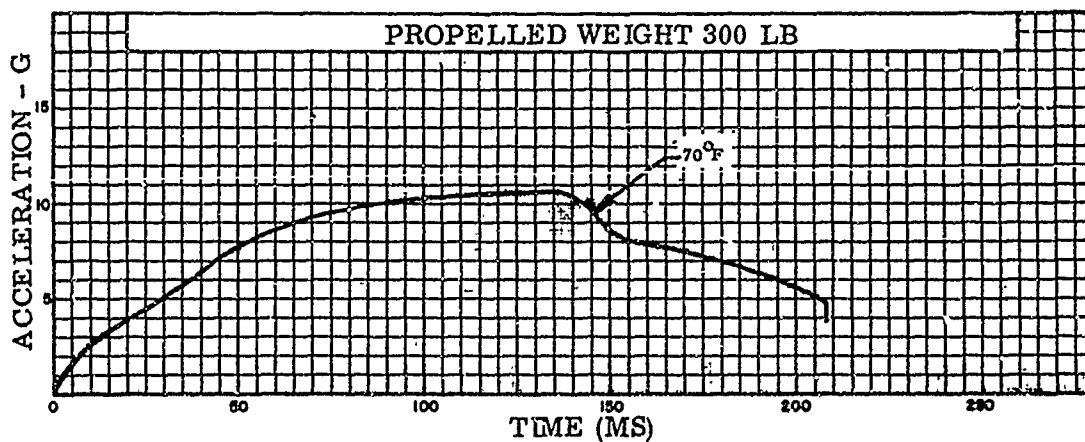
CATAPULT, AIRCRAFT EJECTION SEAT, TRAINING, M2



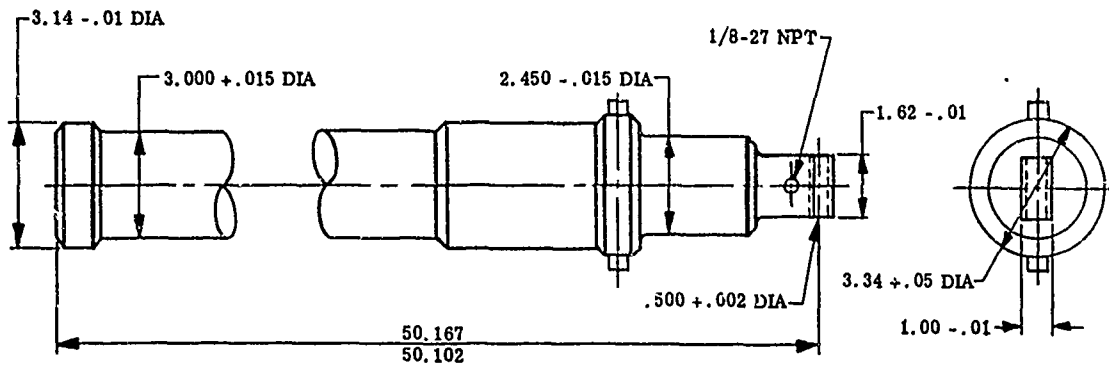
DATA

- | | |
|--|----------------------|
| 1. Stroke | 60.0 in. |
| 2. Weight (total assembly) | 13.6 lbs. |
| 3. Propelled Weight | 300.0 lbs. |
| 4. Temperature Limits | -65°F to +160°F |
| 5. Max Acceleration (at 70°F) | 12.0 g. |
| 6. Velocity, min (at 70°F) | 38 fps. |
| 7. Max Rate of Change of Accel (at 70°F) | 150 g/sec. |
| 8. Firing Method | Mechanical Actuation |
| 9. Stroke Time (at 70°F) | 0.210 s ±. |

TYPICAL PERFORMANCE



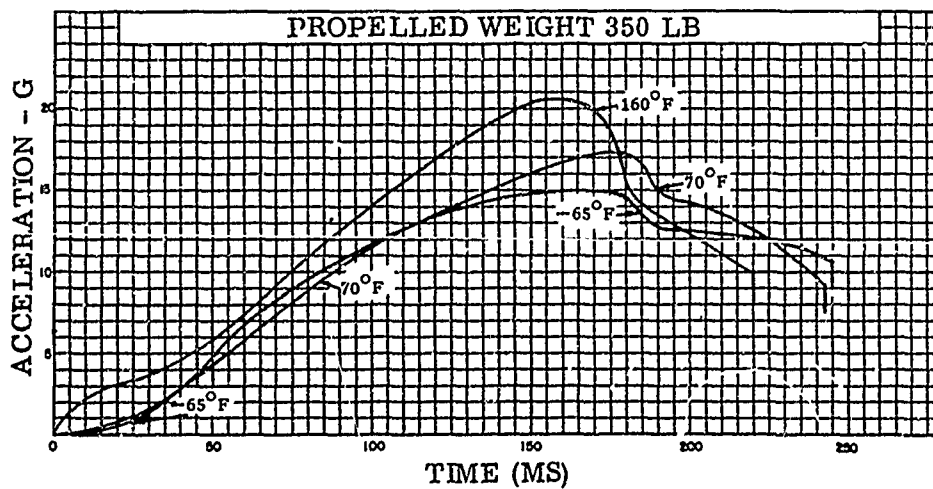
CATAPULT, AIRCRAFT EJECTION SEAT, M3A1



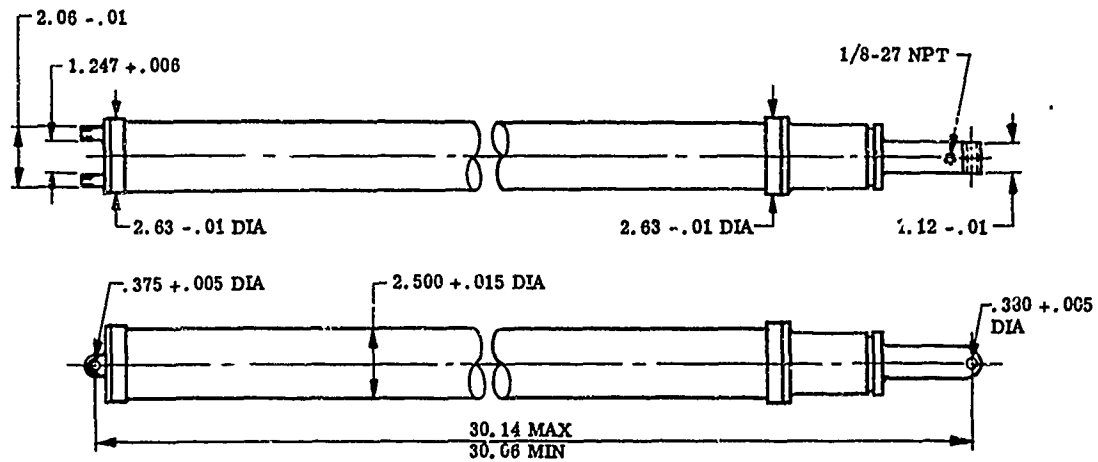
DATA

1. Stroke 88.0 in.
2. Weight (total assembly) 24.9 lbs.
3. Propelled Weight 350.0 lbs.
4. Temperature Limits -65°F to $+160^{\circ}\text{F}$
5. Max Accel. (at 70°F) 20.0 g.
6. Velocity, min. (at 70°F) 77.0 fps.
7. Max Rate of Change of Accel (at 70°F) 180.0 g/sec.
8. Firing Method. Gas Actuation
9. Stroke Time (at 70°F) 0.240 sec.

TYPICAL PERFORMANCE



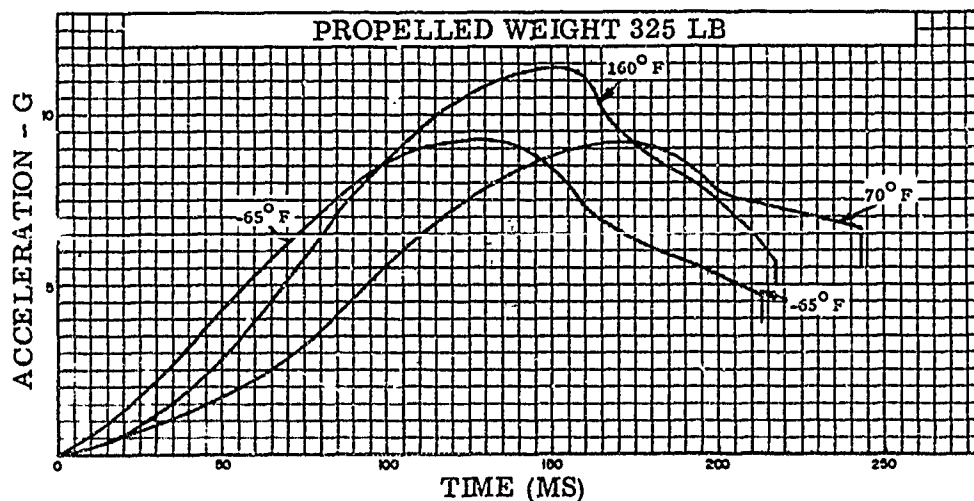
CATAPULT, AIRCRAFT EJECTION SEAT, M4A1



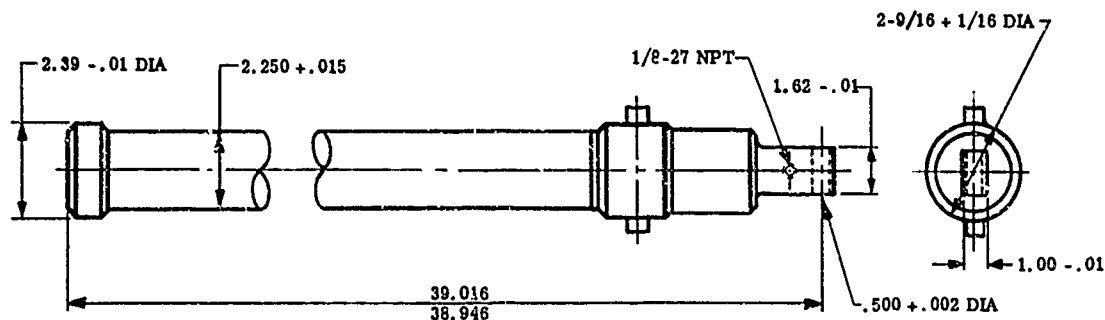
DATA

1. Stroke 45.0 in.
2. Weight (total assembly) 6.7 lbs.
3. Propelled Weight 325.0 lbs.
4. Temperature Limits -65°F to +160°F
5. Max Accel (at 70°F) 12.5 g.
6. Velocity, min. (at 70°F) 38.0 fps.
7. Max rate of change of Accel (at 70°F) 100.0 g/sec.
8. Firing Method Gas Actuation
9. Stroke Time (at 70°F) 0.240 sec.

TYPICAL PERFORMANCE



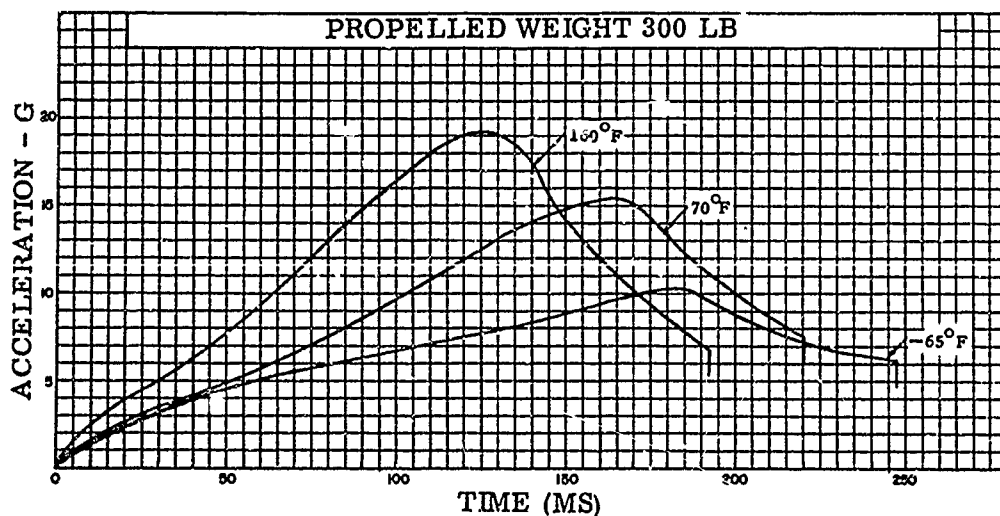
CATAPULT, AIRCRAFT EJECTION SEAT, M5A1



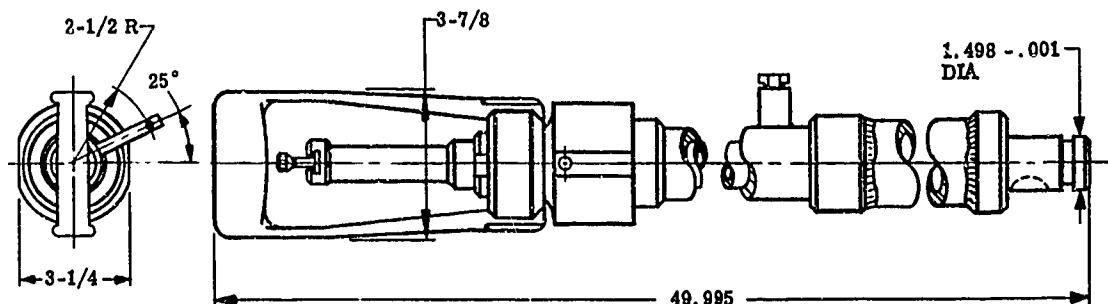
DATA

1. Stroke	66.0 in.
2. Weight (total assy)	8.2 lbs.
3. Propelled Weight	300.0 lbs.
4. Temperature limits	-65°F to +160°F
5. Max Accel (at 70°F)	20.0 g.
6. Velocity, min (at 70°F)	60 fps.
7. Max rate of change of accel (at 70°F)	170.0 g/sec.
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.220 sec.

TYPICAL PERFORMANCE



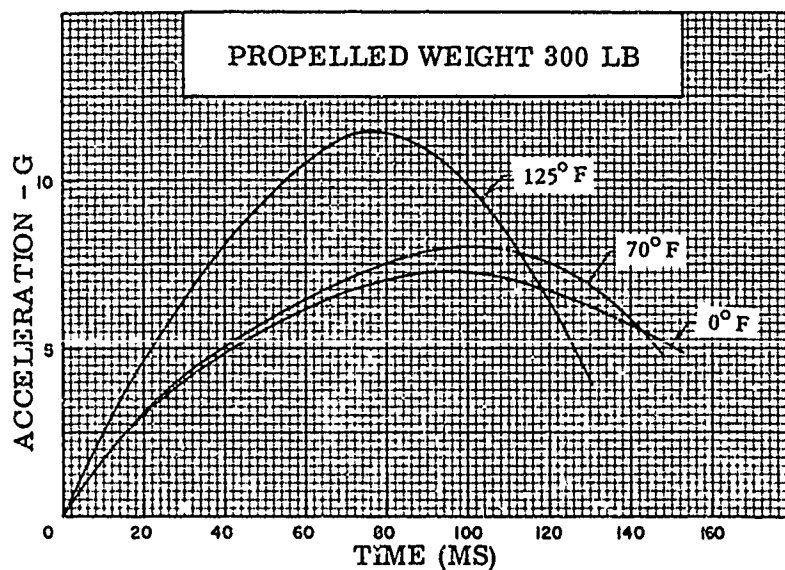
CATAPULT, AIRCRAFT EJECTION SEAT, TRAINING, M6A1



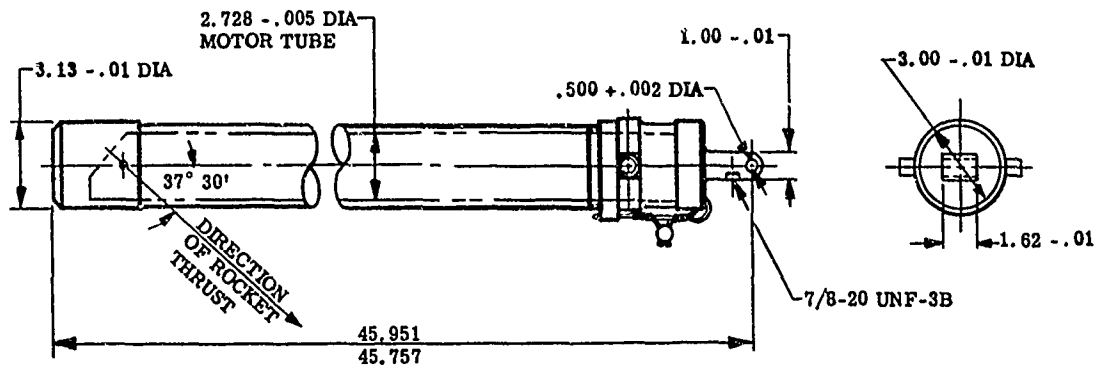
DATA

1. Stroke 21.0 in.
2. Weight (total Assembly) 31.5 lbs.
3. Propelled weight 300.0 lbs.
4. Temperature Limits 40°F to 125°F
5. Max accel (at 70°F) 8.5 g.
6. Firing Method Mechanical Actuation
7. Stroke Time (at 70°F) 0.163 sec.

TYPICAL PERFORMANCE



CATAPULT, AIRCRAFT EJECTION SEAT, M8



DATA

1. Weight (total assembly) 27.0 lbs.
2. Propelled Weight 350.0 lbs.
3. Temperature Limits -65° to +160° F

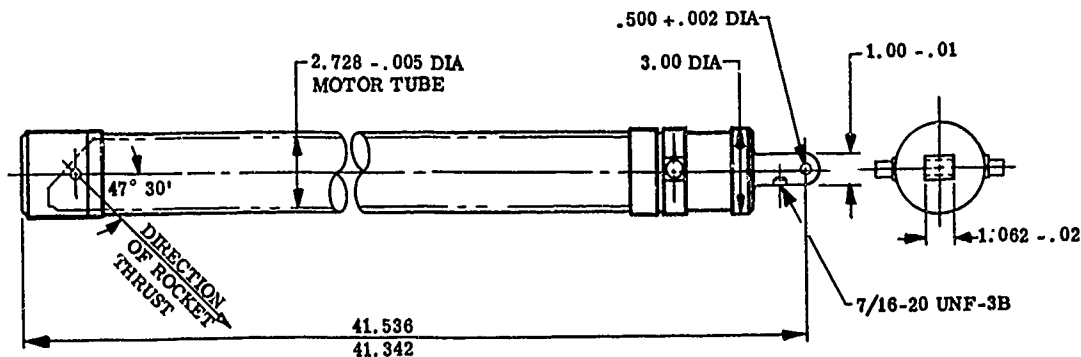
CATAPULT (BOOSTER SECTION)

1. Stroke 40 in.
2. Max Acceleration (at 70° F) 20.0 g.
3. Velocity, minimum (at 70° F) 40.0 fps.
4. Max Rate of Change of Acceleration (at 70° F) 300.0 g/sec.
5. Stroke Time (at 70° F) 0.175 sec.
6. Firing Method Gas Actuation

ROCKET (SUSTAINER SECTION)

1. Action Time, max (at 70° F) 0.400 sec.
2. Impulse (resultant at 70° F) 1200 lb-sec.
3. Pressure, max 4600 psi.
4. Ignition Delay, max (at 70° F) 0.012 sec.
5. Nozzle Angle 37° 30'

CATAPULT, AIRCRAFT EJECTION SEAT, M9



DATA

- 1. Weight (total Assembly) 24.0 lbs.
- 2. Propelled Weight 350 lbs.
- 3. Temperature Limits -65°F to + 160°F

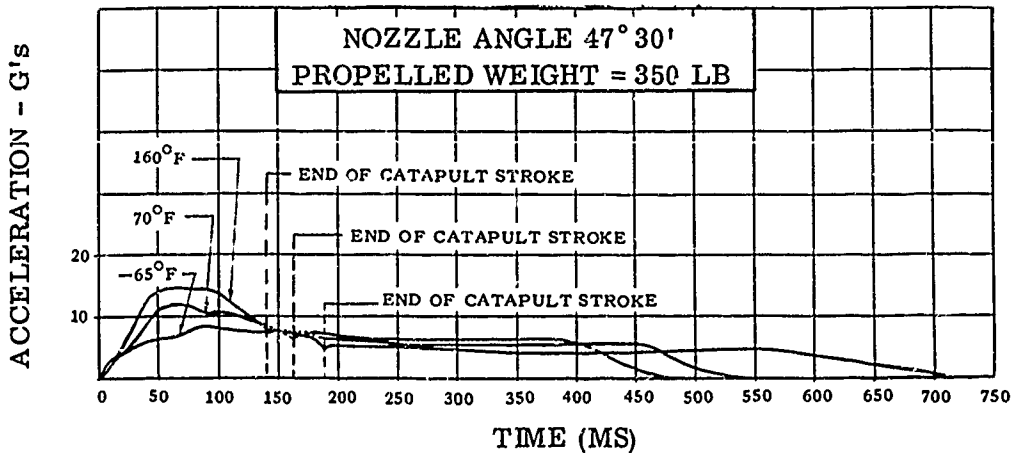
CATAPULT (BOOSTER SECTION)

- 1. Stroke 35-3/4 in.
- 2. Max. Accel. (at 70°F) 20.0 g.
- 3. Velocity, minimum (at 70°F) 40.0 fps.
- 4. Max. Rate of Change of Accel. (at 70°F) 300 g/sec.
- 5. Stroke Time (at 70°F) 0.160 sec.
- 6. Firing Method Gas Actuation

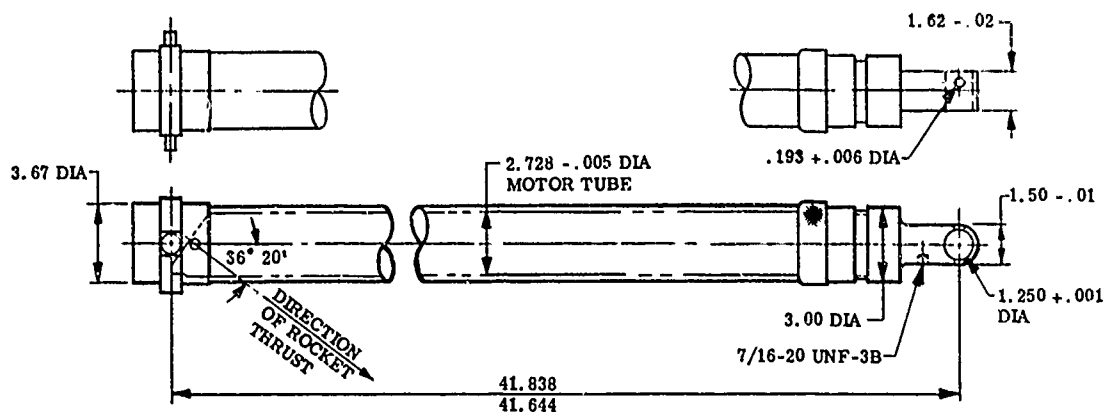
ROCKET (SUSTAINER SECTION)

- 1. Action Time, max. (at 70°F) 0.350 sec.
- 2. Impulse (resultant at 70°F) 1100 lb-sec.
- 3. Pressure, max. 4600 psi.
- 4. Ignition Delay, max. (at 70°F) 0.012 sec.
- 5. Nozzle Angle 47° 30'

TYPICAL PERFORMANCE



CATAPULT, AIRCRAFT EJECTION SEAT, M 10



DATA

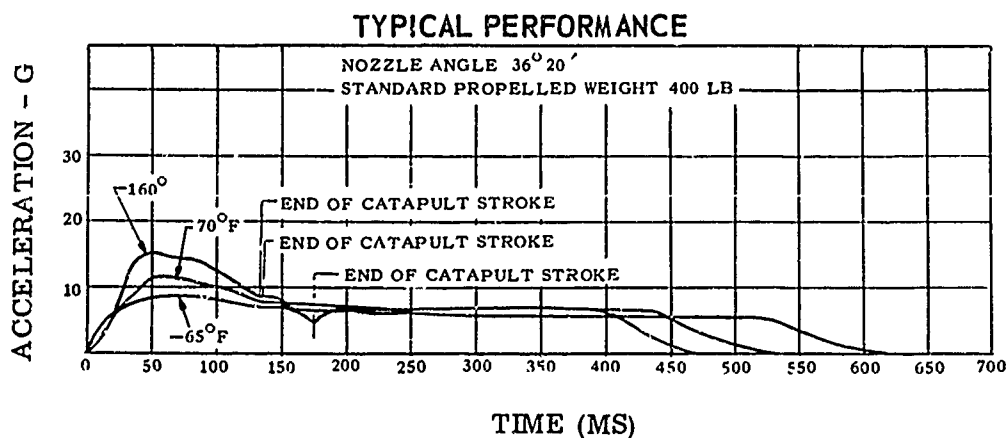
1. Weight (Total Assy) 26.0 lbs.
2. Propelled Weight 400.0 lbs.
3. Temperature Limits -65°F to +160°F

CATAPULT (BOOSTER SECTION)

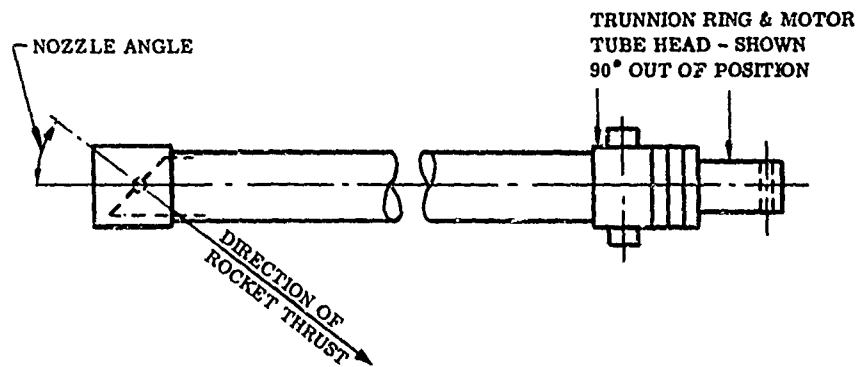
1. Stroke 34.0 in.
2. Max. Acceleration (at 70°F) 20.0 g.
3. Velocity, minimum (at 70°F) 40.0 fps.
4. Max. Rate of Change of Acceleration (at 70°F) 350.0 g/sec.
5. Stroke time (at 70°F) 0.155 sec.
6. Firing Method Gas Actuation

ROCKET (SUSTAINER SECTION)

1. Action Time, max. (at 70°F) 0.400 sec.
2. Impulse (resultant, at 70°F) 1100 lb-sec.
3. Pressure, max. 4600 psi
4. Ignition Delay, max. (at 70°F) 0.012 sec.
5. Nozzle Angle. 36° 20'



CATAPULT, AIRCRAFT EJECTION SEAT For Use As Specified In Table Below



DESIGNATION	STROKE (in.)	NOZZLE ANGLE	PROPELLED MASS (lb.)	VEL. (MIN) AT SEPARATION (ft/sec.)	IMPULSE TOTAL lb. sec	ACCEL. (MAX G AT 70° F.)	ASSEM. WEIGHT lbs.
XM12	40.	45.°	350	42.	1800.	12.	27.
XM13	36.	36° 20'	220	40.	1400.	12.	23.
XM18	34.	45.°	350	40.	1200.	12.	21.
M19	40.	47° 30'	350	42.	1800.	12.	26.
XM20	33-1/2	37.°	350	40.	1620.	12.	23.
XM21	33-1/2	47° 30'	350	40.	1620.	12.	23.
XM22	33-1/2	56.°	350	40.	1620.	12.	23.
XM23	33-1/2	62.°	350	40.	1620.	12.	23.

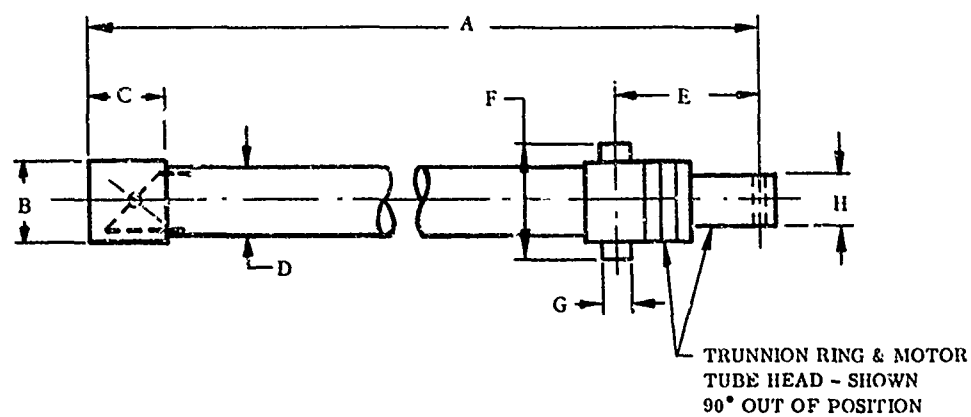
OTHER DATA

1. Operating Temperature Limits -65° F. to +165° F.
2. Firing Method Gas*

* Equivalent (1000 psi-advisory) to that delivered by an M3 type initiator.

The catapult is a propellant actuated device developed for emergency ejection of seat-man combination from high speed aircraft. The rocket component provides the additional thrust required to achieve safe "off-the-deck" escape capability.

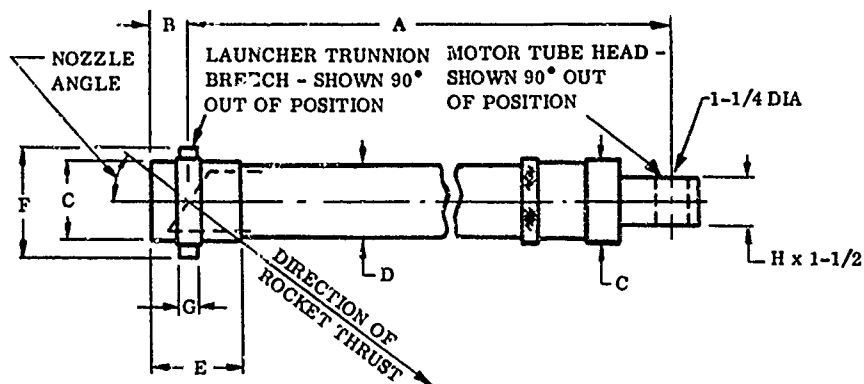
CATAPULT, AIRCRAFT EJECTION SEAT (Cont'd)
XM12, XM13, XM18, M19, XM20, XM21, XM22, And XM23



DIMENSIONAL DATA

DESIGNATION	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	F (in.)	G (in.)	H (in.)
XM12	50-1/8	3-1/8	3-3/16	2-7/8	8-9/16	4-1/8	5/8	1-5/8
XM13	41-1/2	3.	2.83	2-7/8	4-13/16	3.8	9/16, 5/8	1-5/8
XM18	39.	2.4	-----	2.4	4.86	3-3/8	1/2	1-5/8
M19	45-7/8	3-1/8	3-3/16	2-7/8	4-9/32	4-5/32	5/8	1-5/8
XM20	39.	3.	2.83	2-7/8	4-13/16	3.8	9/16, 5/8	1-5/8
XM21	39.	3.	2.83	2-7/8	4-13/16	3.8	9/16, 5/8	1-5/8
XM22	39.	3.	2.83	2-7/8	4-13/16	3.8	9/16, 5/8	1-5/8
XM23	39.	3.	2.83	2-7/8	4-13/16	3.8	9/16, 5/8	1-5/8

CATAPULT, AIRCRAFT EJECTION SEAT For Use As Shown In Table Below



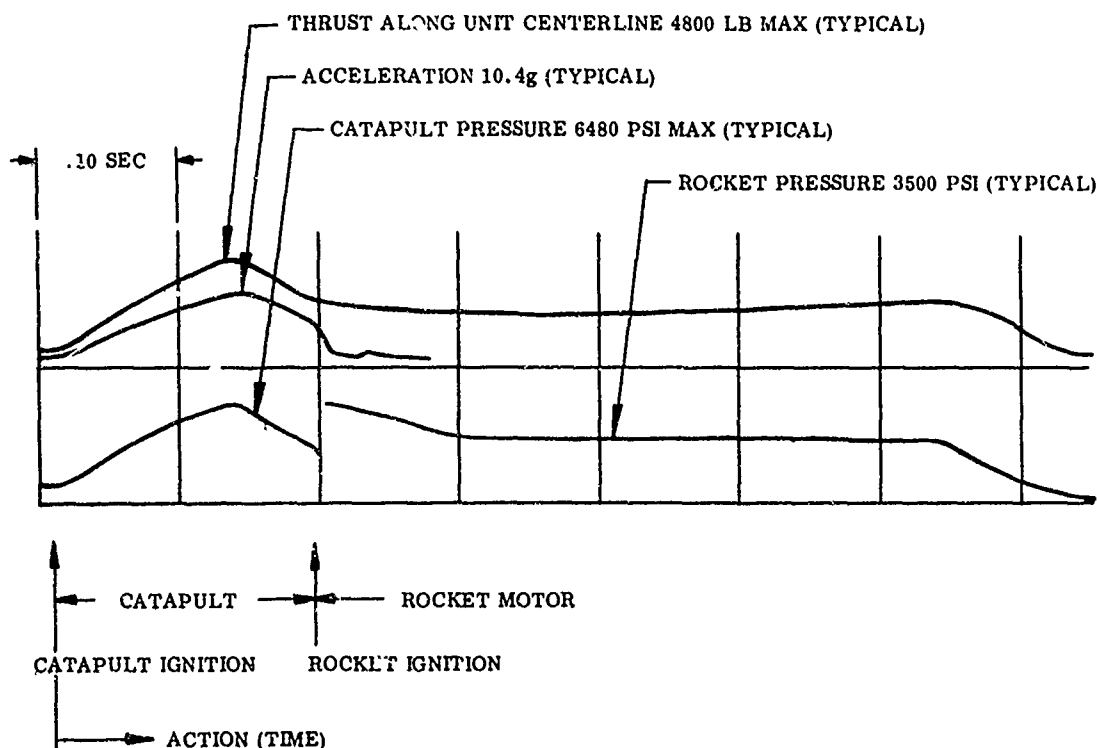
DESIGNATION	STROKE (in.)	NOZZLE ANGLE	PROPELLED MASS (lb.)	VEL. (MIN) AT SEPARATION (ft/sec.)	IMPULSE TOTAL lb. sec.	ACCEL. MAX. G AT 70° F.	ASSEM. WEIGHT lbs.
XM25	34.0	41° 30'	400	40.	1650.	14.	26.
XM26	34.0	see note 3	410	40.	2200.	12.	30.
XM30	34.0	see note 3	410	40.	2200.	12.	30.

DIMENSIONAL DATA

DESIGNATION	A (in.)	B (in.)	C (in.)	D (in.)	E (in.)	F (in.)	G (in.)	H (in.)
XM25	41.72	1.49	3-1/4	2.86	3-1/8	4.42	5/8	1-5/8
XM26	41.78	1.50	see note 4	3-1/8	3.40	4.42	5/8	1-5/8
XM30	41.78	1.16	3-1/4	3-1/8	3.10	4.42	5/8	1-5/8

CATAPULT, AIRCRAFT EJECTION SEAT (Cont'd) XM25, XM26, and XM30

TYPICAL PERFORMANCE

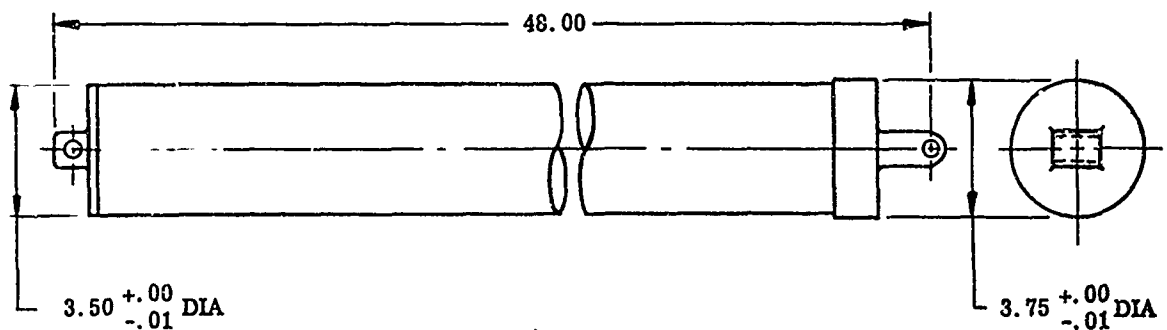


OTHER DATA

1. Operating temperature limits -65°F to $+160^{\circ}\text{F}$
 2. Firing method Gas *
 3. This type item can be supplied with parts to provide a nozzle angle adjustable from 0° to 50° .
 4. Left-hand dimension "C" = $3\frac{1}{4}$. Right-hand dimension "C" is same as dimension "D".
- * Equivalent (1000 psi - advisory) to that delivered by an M3 type initiator.

The catapult is a propellant actuated device developed for emergency ejection of seat-man combination from high speed aircraft. The rocket component provides the additional thrust required to achieve safe "off-the-deck" escape capability.

CATAPULT, AIRCRAFT, EJECTION SEAT, XM-34 (GUN-LAUNCHED)

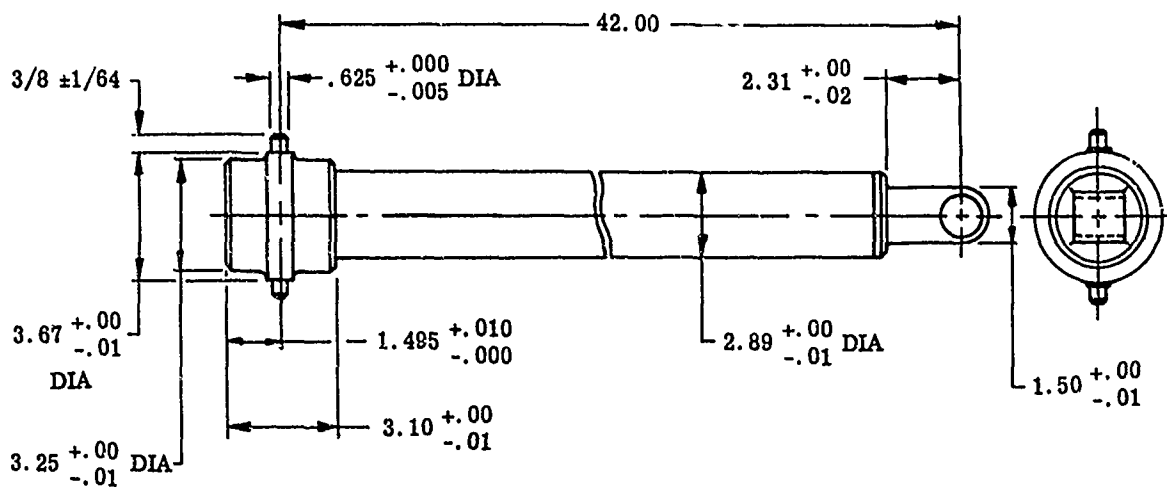


DATA

1. Weight of Assembly 34 lb.
2. Function Time5 sec.
3. Stroke 34 in.
4. Thrust (maximum). 7000 lb.
5. Nozzle angle. As determined
6. Velocity (maximum). 140 ft./sec.
7. Operating Temperature Limits. -65° F. to +200° F.
8. Ejected Weight. 350 lb.

This catapult is a gun-launched rocket seat ejection device used to eject a seat-man combination from high speed aircraft.

CATAPULT, AIRCRAFT EJECTION SEAT, XM-36

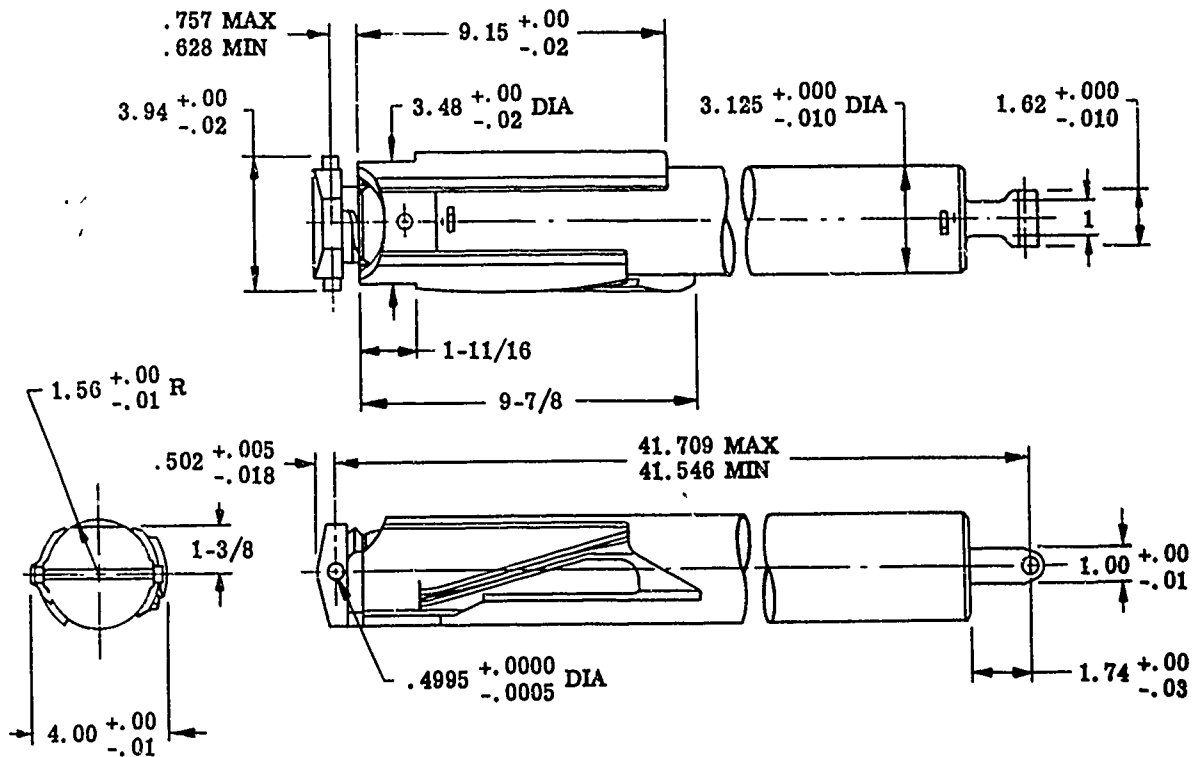


DATA

1. Weight of Assembly	20 lb.
2. Function Time	450 ms.
3. Stroke	34 in.
4. Thrust (maximum)	5000 lb.
5. Velocity (max. at separation)	50 ft./sec.
6. Operating Temperature Limits	-65° F. to +200° F.
7. Ejected Weight	383 lb.
8. Nozzle angle	As determined

This catapult is a cartridge actuated device designed for emergency ejection of a seat-man combination from high speed aircraft.

CATAPULT AIRCRAFT, EJECTION SEAT, XM-38

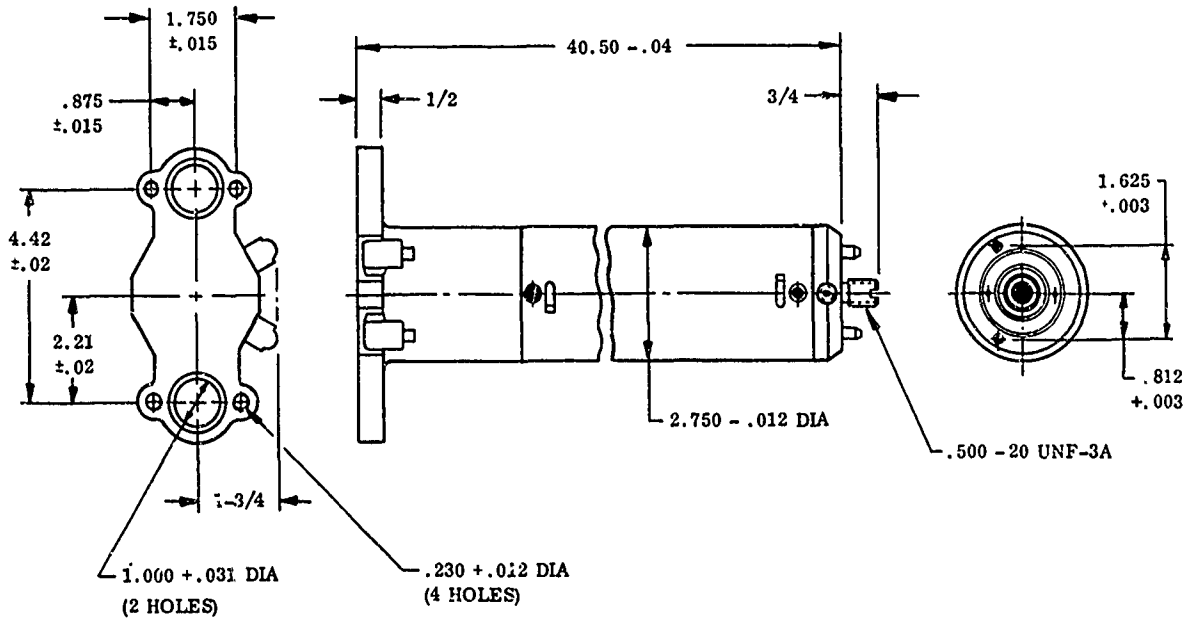


DATA

1. Weight of Assembly. 35 lb. (Estimated)
2. Stroke. 34 in. (Booster only)
3. Impulse 1100 lb.-sec. (Rocket only)
4. Nozzle Angle Adjustment Range 38° 50' to 52° 0'
5. Velocity (max. at separation) 48 ft./sec.
6. Operating Temperature Limits -65°F. to +165°F.
7. Ejected Weight 383 lb. (50 Percentile man)

This catapult is a cartridge actuated device designed for emergency ejection of a seat-man combination from the F-5/T-38 Aircraft.

XM-39 ROCKET CATAPULT



DATA

1. Weight of Assembly	19.5 lbs.
2. Stroke.	34 in. (Booster only)
3. Impulse	1140 lb.-sec. (Rocket only)
4. Nozzle Angle	60° (other positions as req'd)
5. Velocity (max. at separation)	52 ft./sec.
6. Operating Temp. Limits	-65°F to + 200°F
7. Ejected Weight	363 lb. (50 percentile man)

TYPICAL PERFORMANCE

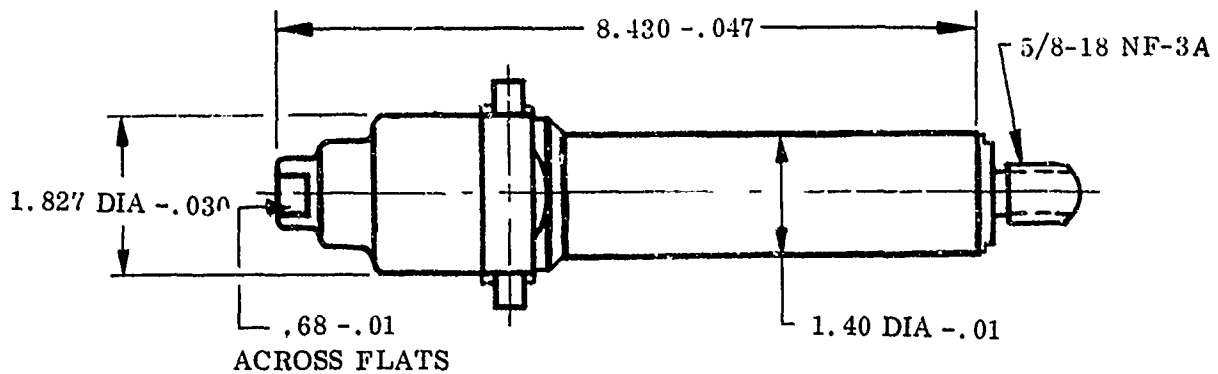
This catapult is designed for use in the advanced concept ejection seat (ACES) and is initiated by dual electric apollo standard initiators. It is also easily adaptable for gas initiation.

THRUSTERS

The thruster is a propellant actuated device principally developed to serve as a source of energy to move a weight or overcome a resistive force such as position the seat in an aircraft or unlock a canopy prior to ejection of the crewman. Thrusters are designed as a closed ballistic system so that the piston does not separate under the range of operating conditions including "lock-shut" and "no-load" firings.

Some thrusters have provisions to bypass the gas to initiate another PAD unit during or after power stroke of the piston. In yet another type of thruster the unit is oil damped for controlled thrust, velocity, acceleration, or rate of change of acceleration.

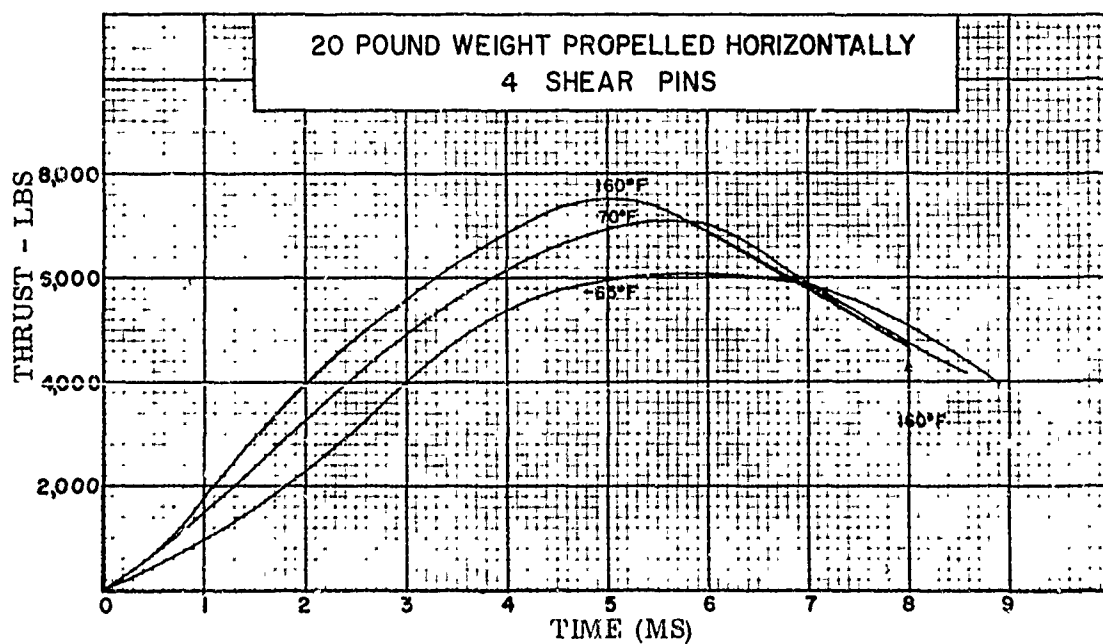
THRUSTER, M1A2



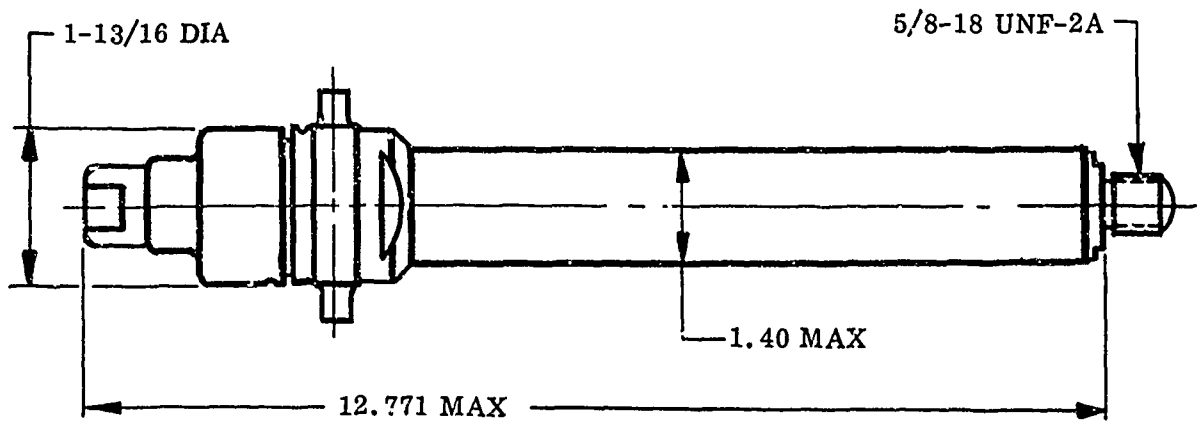
DATA

1. Average Peak Thrust	6900 lbs.
2. Completed Stroke	2 in. (min.)
3. Average Stroke Time	0.009 sec.
4. Assembled Weight	3.2 lbs.
5. Propelled Weight, Horizontal	20 lbs.
6. Firing Method	Propellant Gas
7. Temperature Limits	-65° F to +200° F
8. Restraining Force	1000 lbs. @ .00 in. stroke; 6000 lbs. @ .25 in. stroke

TYPICAL PERFORMANCE



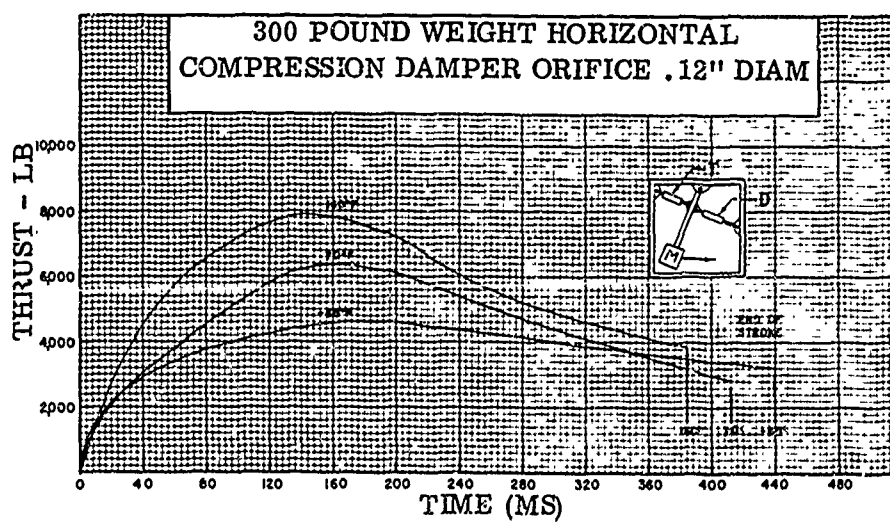
THRUSTER, M2A2



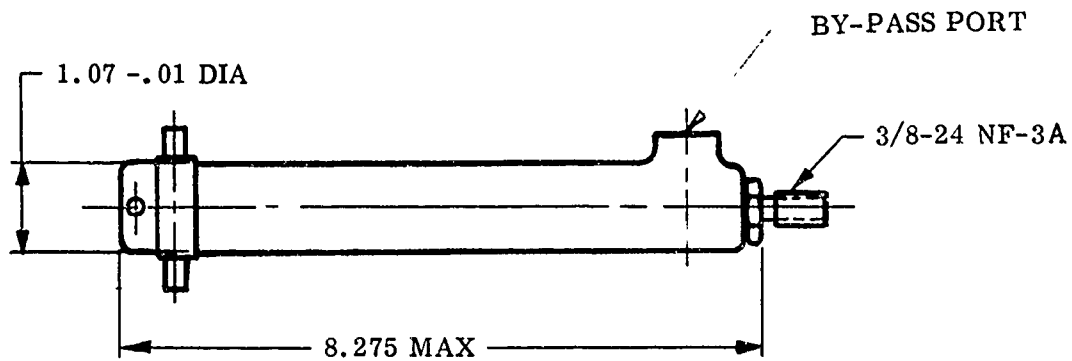
DATA

1. Average Peak Thrust w/Seat in Horizontal
Position @ 70°F 6170 lbs.
2. Completed Stroke 5.7 in.
3. Velocity, Maximum 12 ft/sec.
4. Assembled Weight 4.0 lbs.
5. Propelled Weight, Horizontal 300 lbs.
6. Firing Method Propellant Gas
7. Temperature Limits -65°F to +200°F
8. Average Stroke Time w/Seat in Horizontal
Position @ 70°F410 sec.

TYPICAL PERFORMANCE



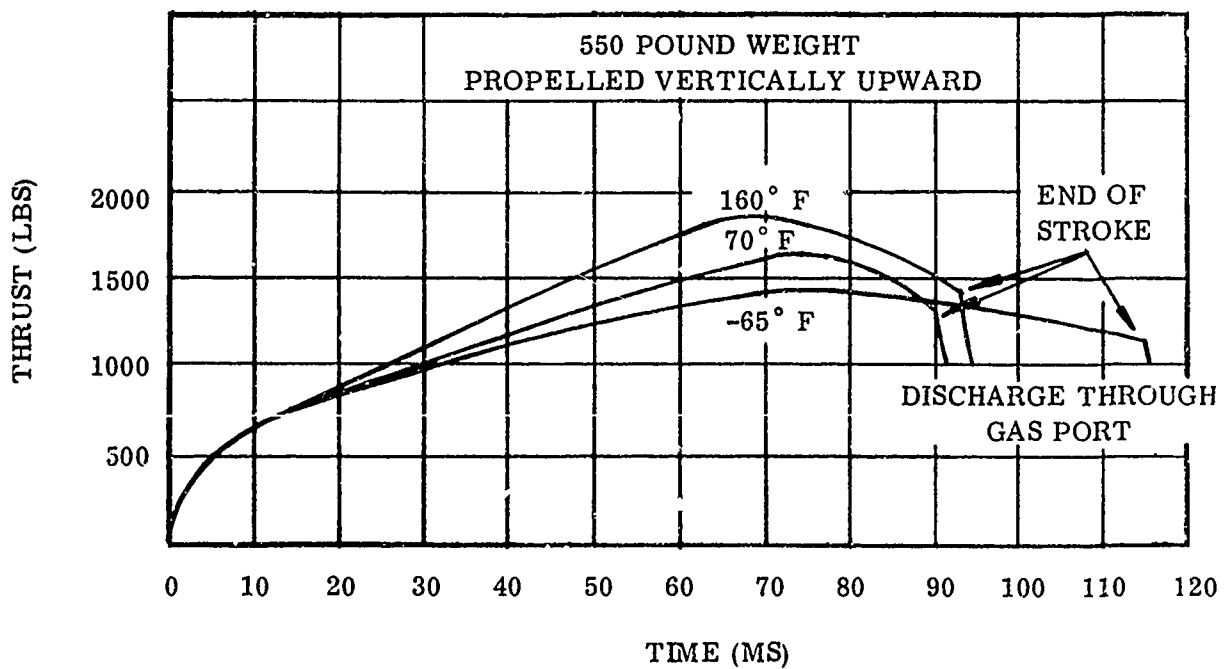
THRUSTER, M3A3



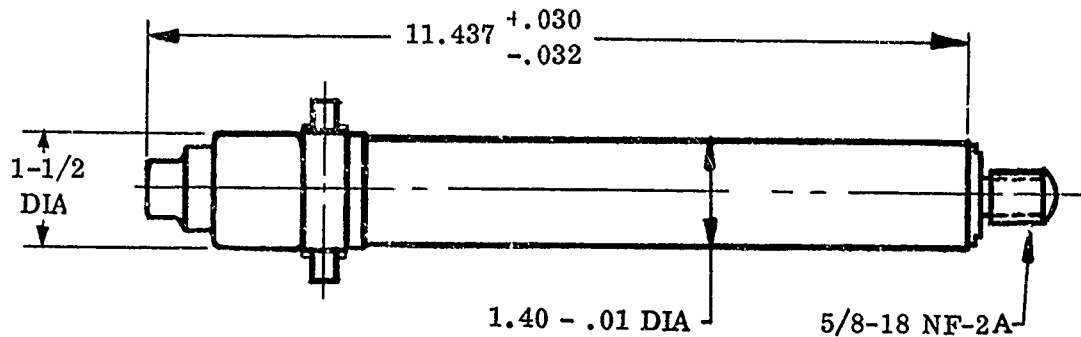
DATA

1. Average Peak Thrust Under Normal Load
@ 70°F 1660 lbs.
2. Completed Stroke 1-1 1/2 in., min.
3. Assembled Weight 1.0 lbs.
4. Propelled Weight, Vertical 550 lbs.
5. Firing Method Propellant Gas
6. Temperature Limits -65°F to +200°F
7. By-Pass Pressure @ 70°F Under Normal Load at
the End of 4 Ft. Length of #4 Hose 600 psi, min.
8. Average Stroke Time090 sec.

TYPICAL PERFORMANCE



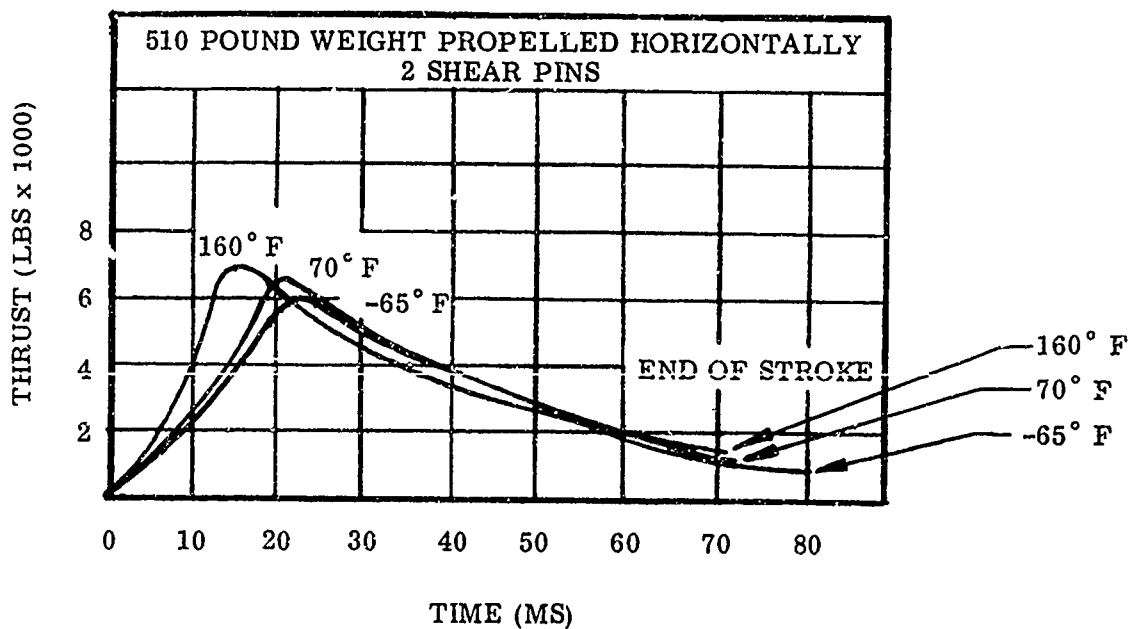
THRUSTER, M5A2



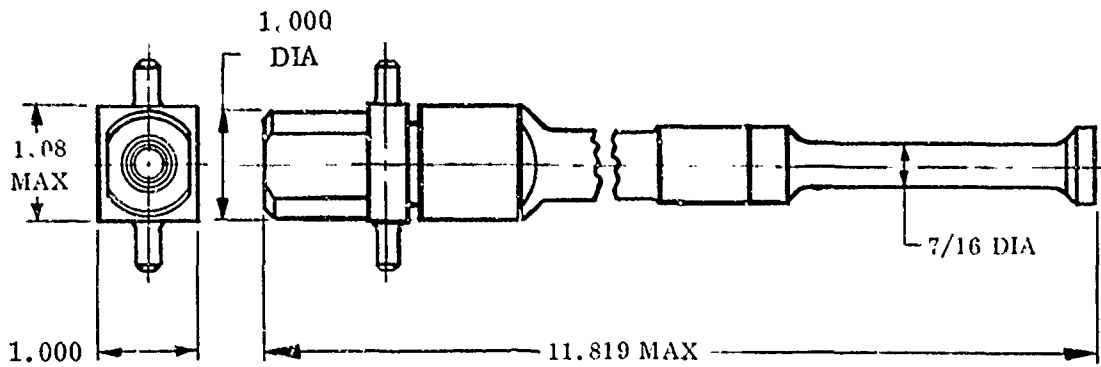
DATA

1. Average Peak Thrust Under Normal Load @ 70° F. . . 6670 lbs.
2. Completed Stroke 5.0 in.
3. Average Stroke Time Under Normal Load @ 70° F.075 sec.
4. Assembled Weight. 3.6 lbs.
5. Propelled Weight, Horizontal 500 lbs.
6. Firing Method. Propellant Gas
7. Temperature Limits -65° F to $+200^{\circ}$ F
8. Restraining Forces 4000 lbs. @ .0 inches of stroke
1000 lbs. @ .5 inches of stroke

TYPICAL PERFORMANCE



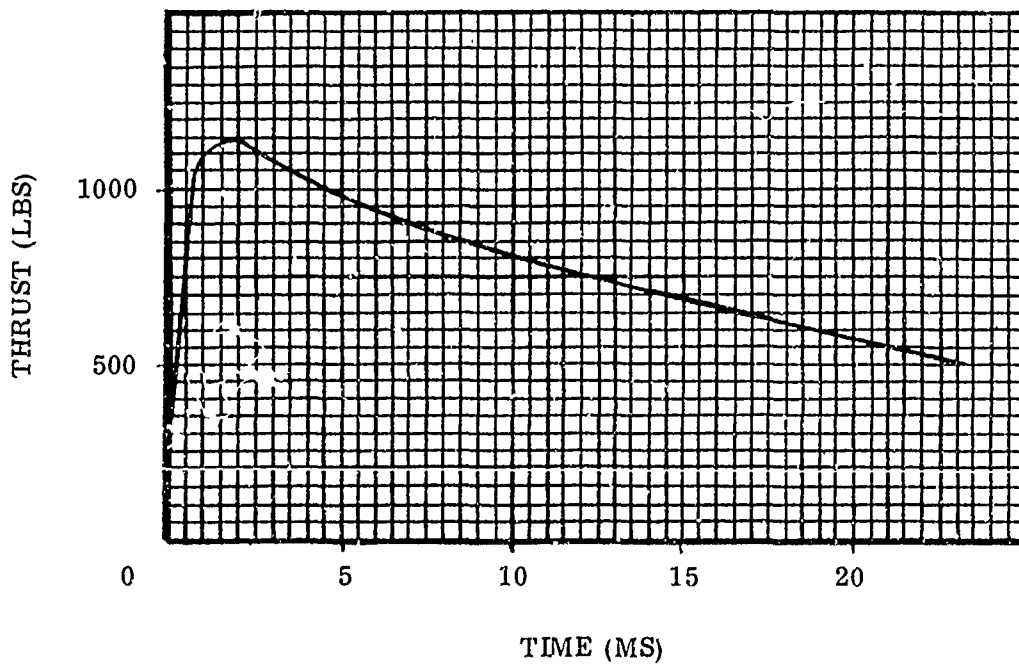
THRUSTER, M6



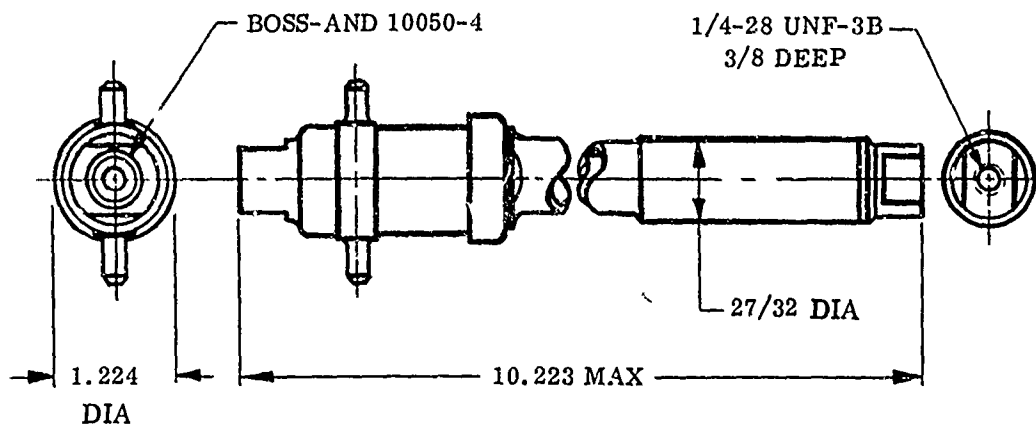
DATA

1. Average Peak Thrust Under Load @ 70° F 1100 lbs.
2. Completed Stroke 1.5 in.
3. Assembled Weight 1.0 lbs.
4. Propelled Weight, Horizontal 60 lbs.
5. Firing Method Propellant Gas
6. Temperature Limits -65° F to +200° F
7. Restraining Force 400 lbs.

TYPICAL PERFORMANCE



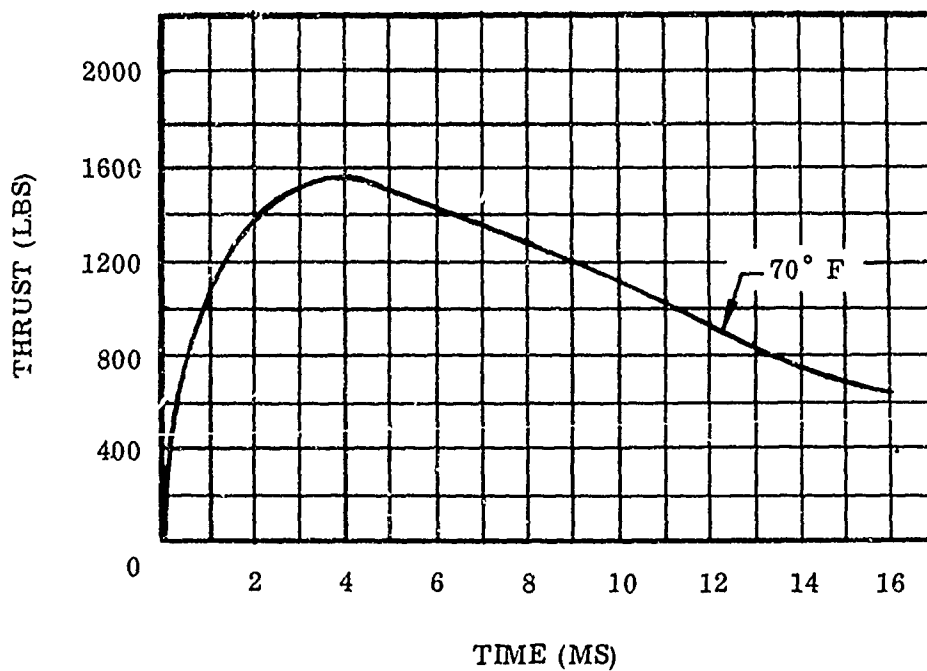
THRUSTER, M7



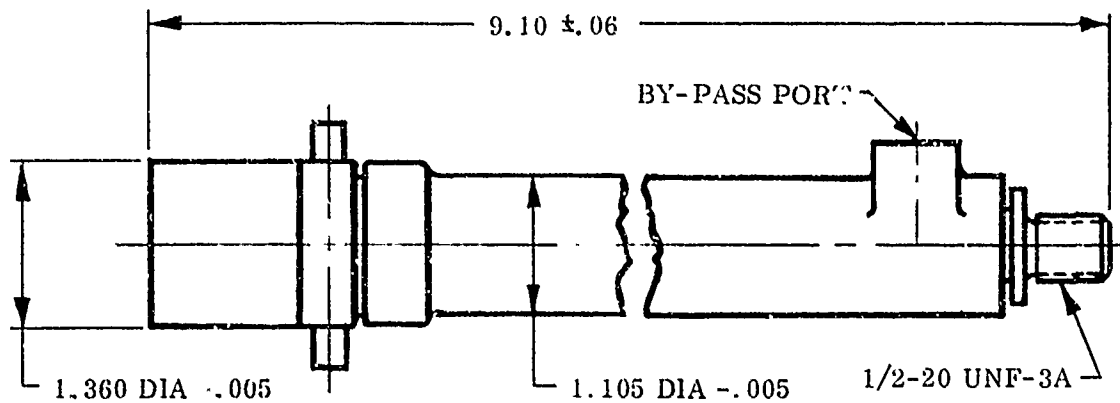
DATA

1. Average Peak Thrust Under Normal Load
@ 70°F 1600 lbs.
2. Complete Stroke. 2.5 in.
3. Average Stroke Time.070 sec.
4. Assembled Weight. 1.08 lbs.
5. Propelled Weight, Horizontal 11.6 lbs.
6. Firing Method. Propellant Gas
7. Temperature Limits -65°F to +200°F
8. Restraining Force. 500 lbs.

TYPICAL PERFORMANCE



THRUSTER, M9

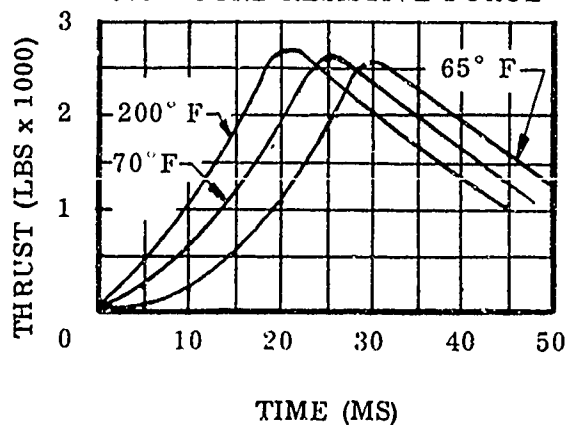


DATA

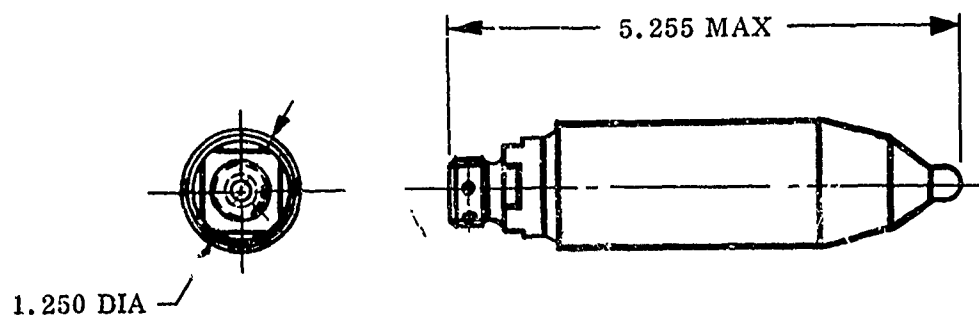
1. Average Peak Thrust Under Load
@ 70° F. 2600 lbs.
2. Completed Stroke 3.6 in. (min.)
3. Operating Time080 sec.
4. Assembled Weight 1.0 lb.
5. Propelled Weight, Horizontal 50 lbs.
6. Firing Method Propellant Gas
7. Temperature Limits -65° F to 200° F
8. Restraining Force 500 lbs.
9. By-Pass Pressure Under Normal Load at the
End of 42 Inch Length of #4 Hose 1000 psi (min.)

TYPICAL PERFORMANCE

LOAD PROPELLED HORIZONTALLY
50-POUND WEIGHT
500-POUND RESISTIVE FORCE



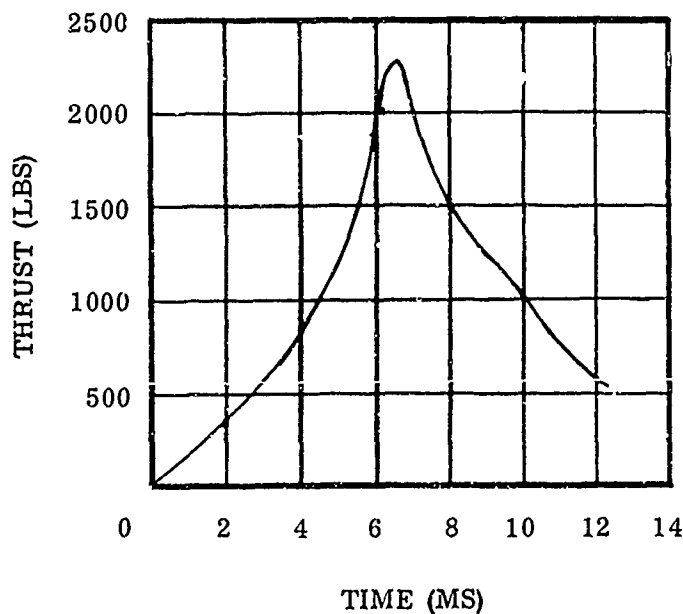
THRUSTER, M11



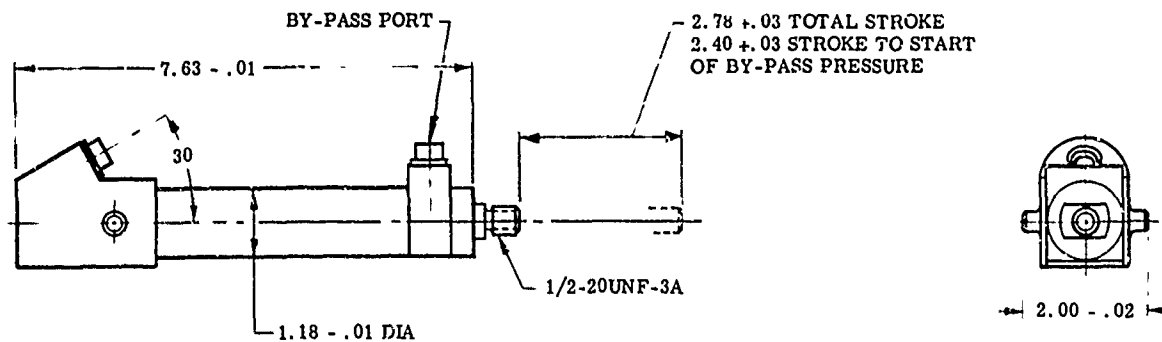
DATA

1. Average Peak Thrust Under Normal Load
@ 70°F 2272 lbs.
2. Completed Stroke 5.75 in.
3. Assembled Weight95 lbs.
4. Propelled Weight, Radially 45 lbs.
5. Firing Method Propellant Gas
6. Temperature Limits -65°F to +200°F
7. Average velocity of propelled mass 5 rad/sec.

TYPICAL PERFORMANCE



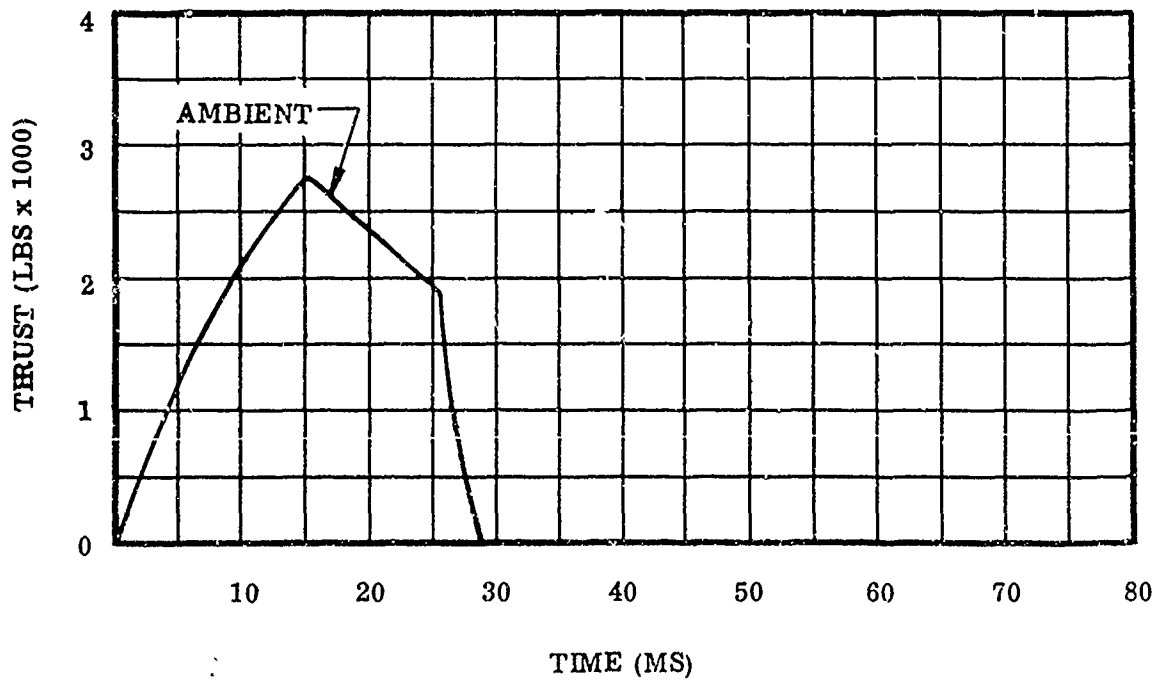
THRUSTER, M13



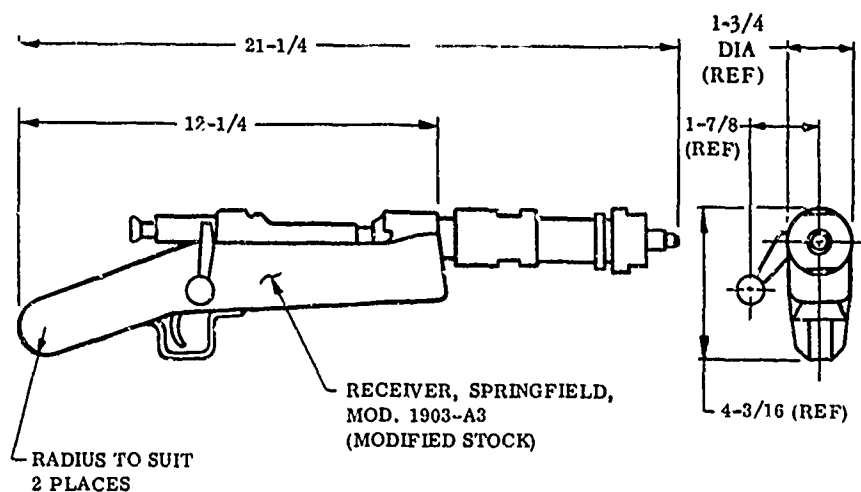
DATA

1. Thrust Under Load @ 70° F 2700 lbs.
2. Completed Stroke 2.86 in., max.
3. Assembled Weight 1.07 lbs.
4. Propelled Weight, Vertical 70 lbs.
5. Firing Method Propellant Gas
6. Temperature Limits -65° F to +200° F
7. By-Pass Pressure Under Load @ 6 Foot of
#4 Hose 1000 lbs., min.
8. Restraining Force 2000 lbs. @ "O" inches
of stroke
9. Operating Time080 sec., max.

TYPICAL PERFORMANCE



THRUSTER, CARTRIDGE ACTUATED, XM-14

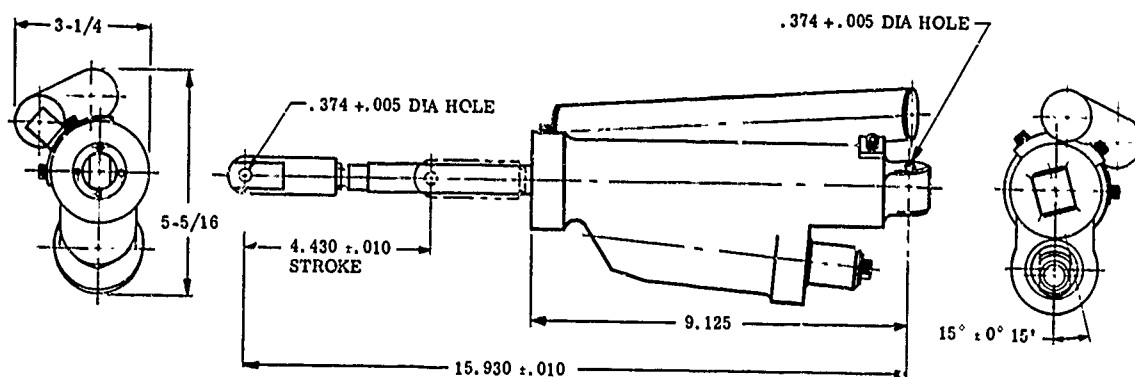


DATA

- | | |
|---|--|
| 1. Firing Cycle | 25 rounds minimum,
without maintenance. |
| 2. Stroke | 11 in. (max.) |
| 3. Projectile Chambering Velocity | 10 to 20 fps. |
| 4. Piston return | Manually repositioned |
| 5. Recharging Rate | 3 to 4 rounds per minute. |
| 6. Operating Temperature | -65° F to +200° F |
| 7. Life Expectancy | 500 to 1000 cycles (design) |

The XM-14 Thruster provides the ramming force necessary to drive a 95 pound projectile a distance of 61 inches into the breech of the 155 mm. Howitzer used in the T-196 Tank.

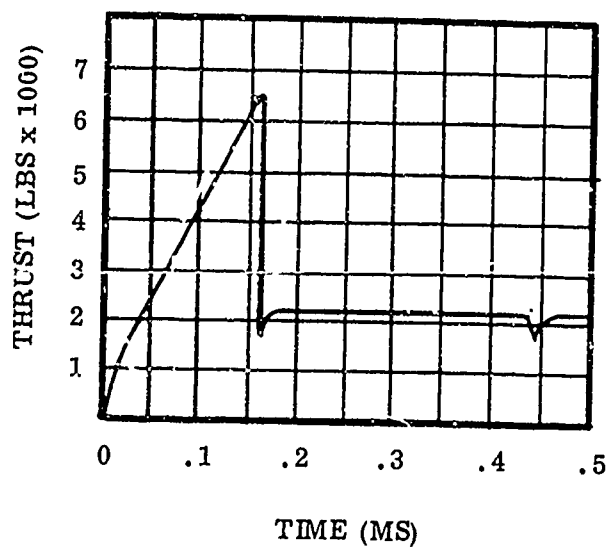
THRUSTER, M-15



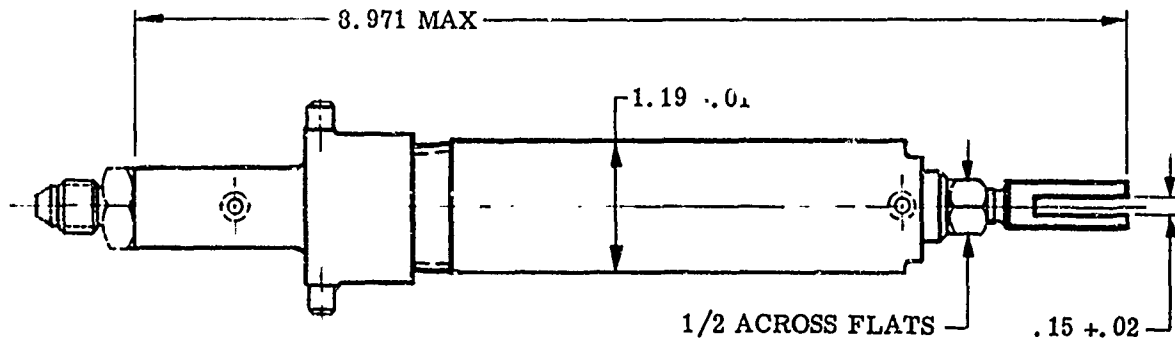
DATA

1. Approximate Thrust	6700 lbs.
2. Completed Stroke.	4.42 in.
3. Assembled Weight	5.0 lbs.
4. Firing Method	Propellant Gas
5. Temperature Limits.	-65°F to $+200^\circ\text{F}$
6. Propelled Mass	11 lbs.
7. Operating Time @ -65°F	500 ms
8. Oil Damped	

TYPICAL PERFORMANCE



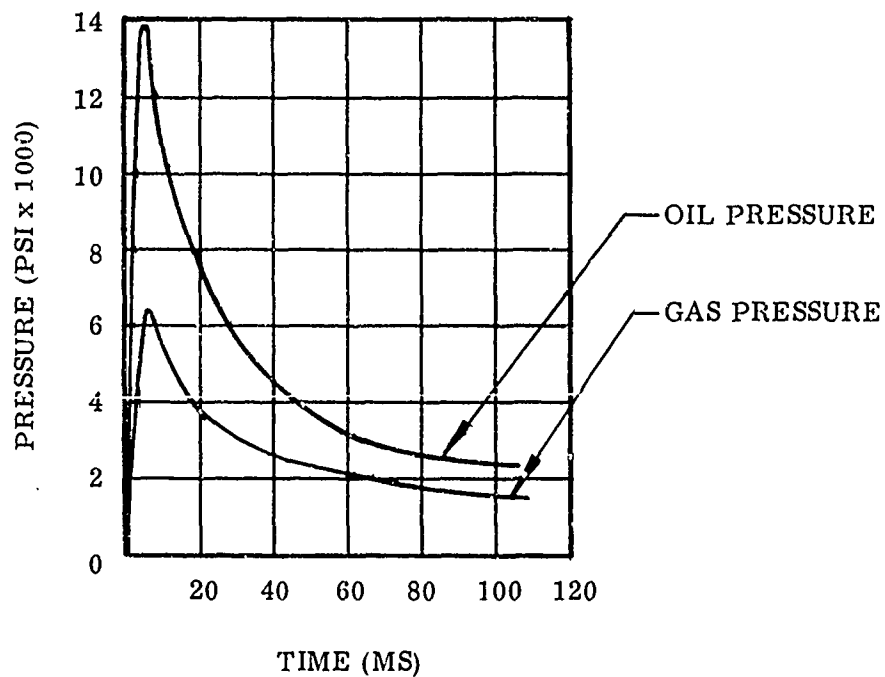
THRUSTER, M16



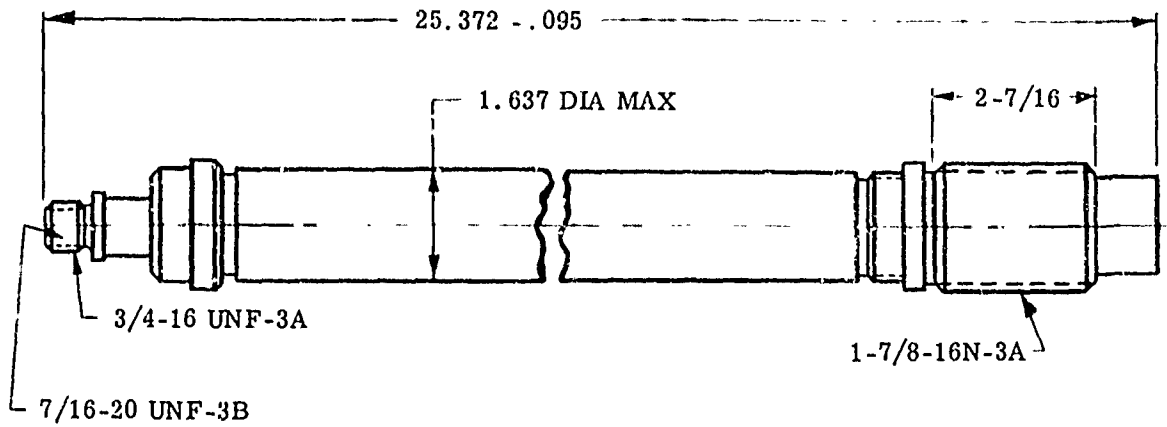
DATA

1. Approximate Peak Thrust 200 lbs.
2. Completed Stroke 3.137 max.
3. Assembled Weight 1.6 lbs.
4. Firing Method Propellant Gas
5. Temperature Limits -65° F to +200° F
6. Operating Time070 sec. to .130 sec.
7. Oil Damped

TYPICAL PERFORMANCE



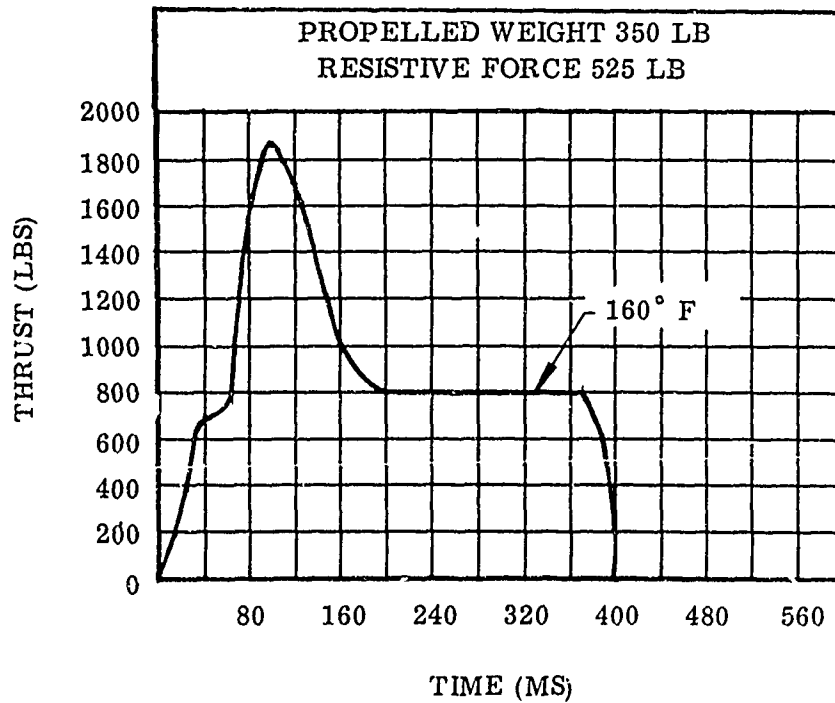
THRUSTER, M17



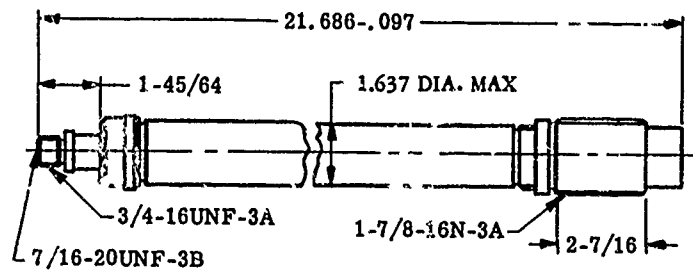
DATA

1. Average Peak Thrust Under Load
@ +165°F 1600 lbs.
2. Completed Stroke 13-1/4 in.
3. Max. Piston Velocity 12 ft/sec.
4. Assembled Weight 13.0 lbs.
5. Firing Method Propellant Gas
6. Temperature Limits -65°F to +200°F
7. Propelled Weight, Horizontal 350 lbs.
8. Restraining Force 525 lbs.
9. Oil Damped

TYPICAL PERFORMANCE



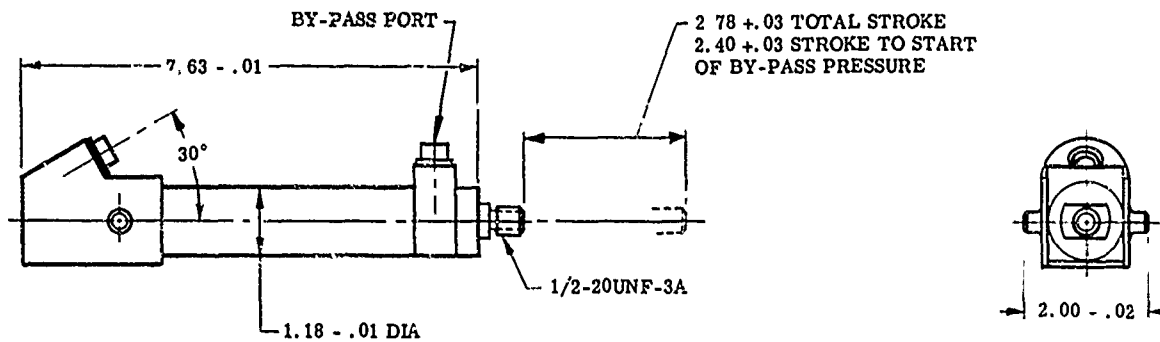
THRUSTER, M18



DATA

1. Average Thrust Under Load @ +165° F 1600 lbs.
2. Completed Stroke 9-1/2 in.
3. Max. Piston Velocity 12 ft/sec.
4. Assembled Weight 12 lbs.
5. Firing Method Propellant Gas
6. Temperature Limits -65° F to +200° F
7. Propelled Weight 350 lbs.
8. Retaining Force. 525 lbs.
9. Oil Damped.

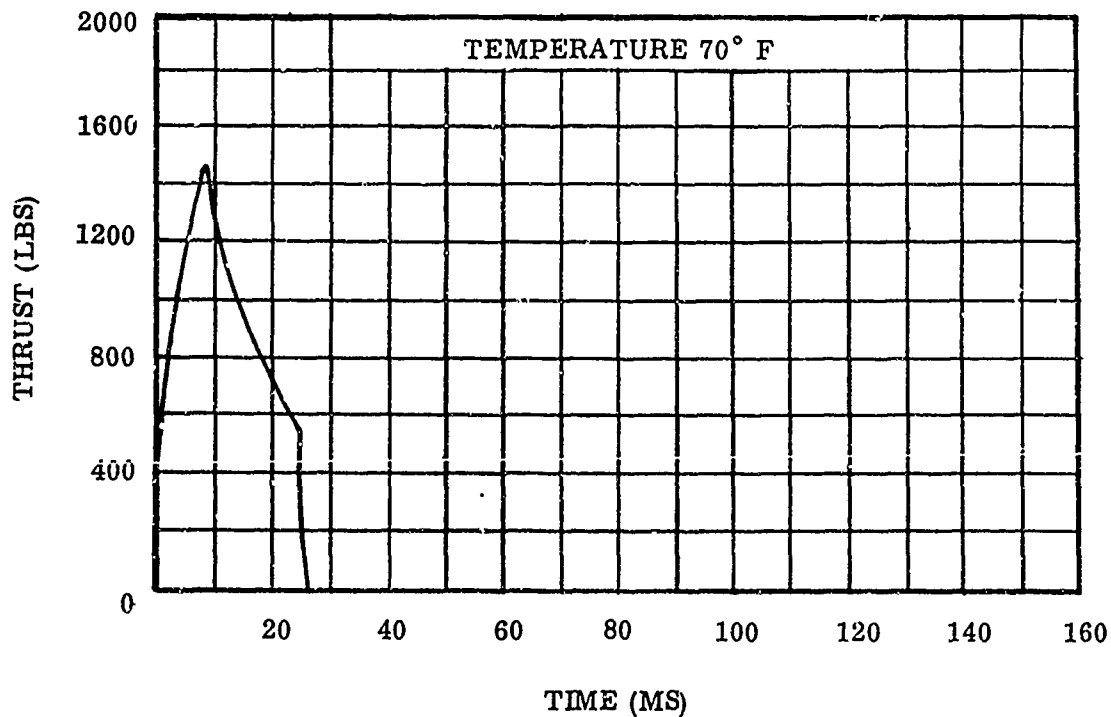
THRUSTER, M19



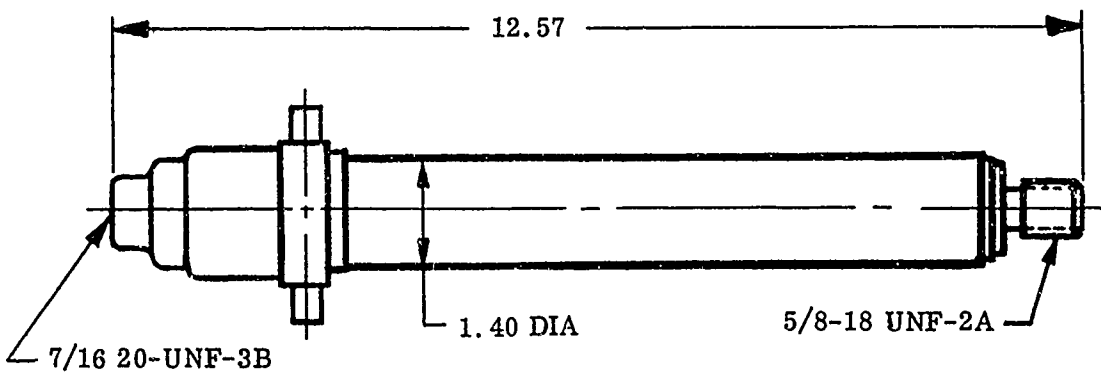
DATA

1. Peak Thrust Under Load @ 70° F. 1470 lbs.
2. Completed Stroke 2.86 in.,
3. Assembled Weight 1.07 lbs.
4. Propelled Weight 75 lbs.
5. Firing Method Propellant Gas
6. Temperature Limits -65° F to + 200° F
7. By-Pass Pressure Under Load @ 13 Feet
6 Inch Length of #4 Hose 1000 psi (min.)
8. Restraining Force 25 lbs. @ "0" inch stroke,
500 lbs. @ "2.4" inch
stroke
9. Operating Time080 sec., mas.

TYPICAL PERFORMANCE



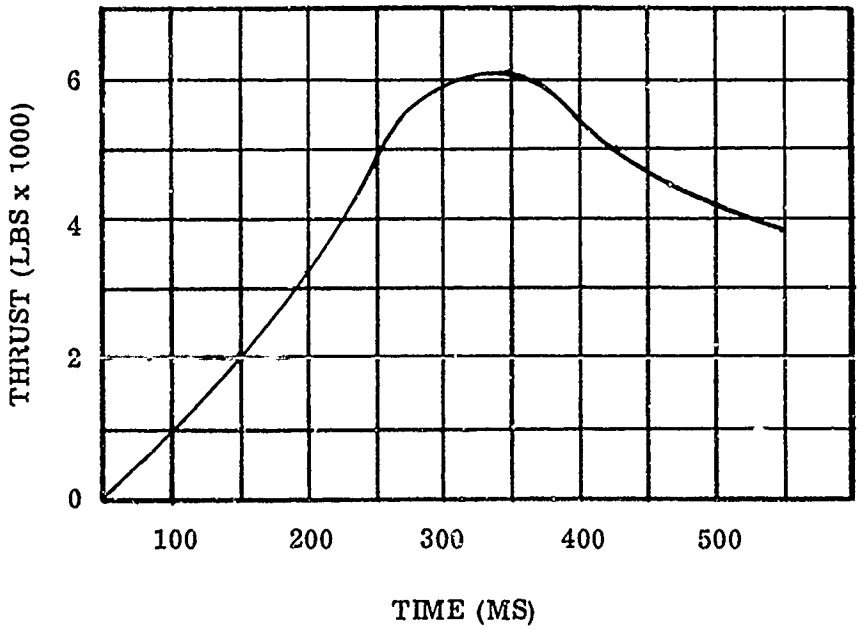
THRUSTER, M20A1



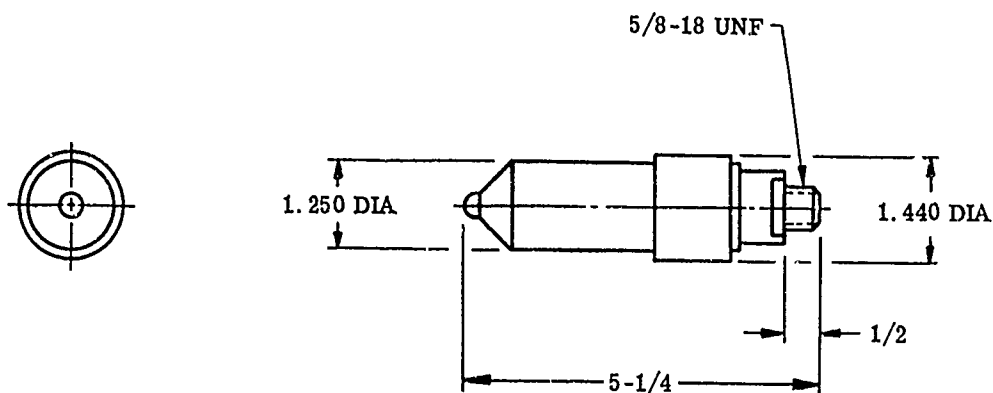
DATA

- 1. Average Peak Thrust Under Normal Load @ 70°F. 5877 lbs.
- 2. Completed Stroke 5.0 in.
- 3. Average Stroke Time046 sec.
- 4. Assembled Weight. 3.6 lbs.
- 5. Propelled Weight, Horizontal 50 lbs.
- 6. Firing Method Propellant Gas
- 7. Temperature Limits -65°F to +200°F
- 8. Restraining Force. 3000 lbs.

TYPICAL PERFORMANCE



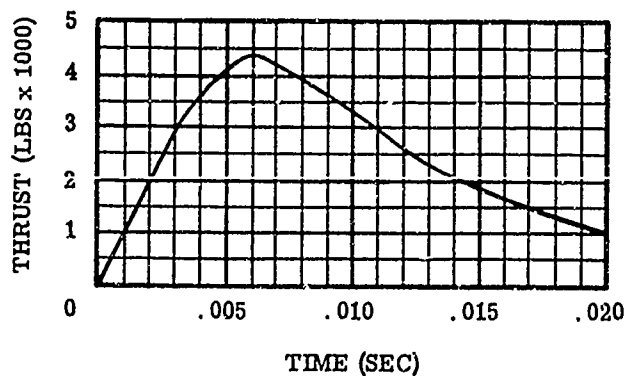
THRUSTER, CARTRIDGE ACTUATED, XM-26



DATA

1. Average Peak Thrust Under Normal Load @ 70° F • 4400 lbs.
2. Completed Stroke • • • • • 4.95 in.
3. Assembled Weight • • • • • 1.0 lb.
4. Propelled Wt. Radially • • • • • 45 lbs.
5. Firing Method • • • • • Gas
6. Operating Temperature Limits • • • • • -65° F thru + 200° F.
7. Avg. Vel. of Propelled Mass • • • • • 13 Rad/Sec.

TYPICAL PERFORMANCE

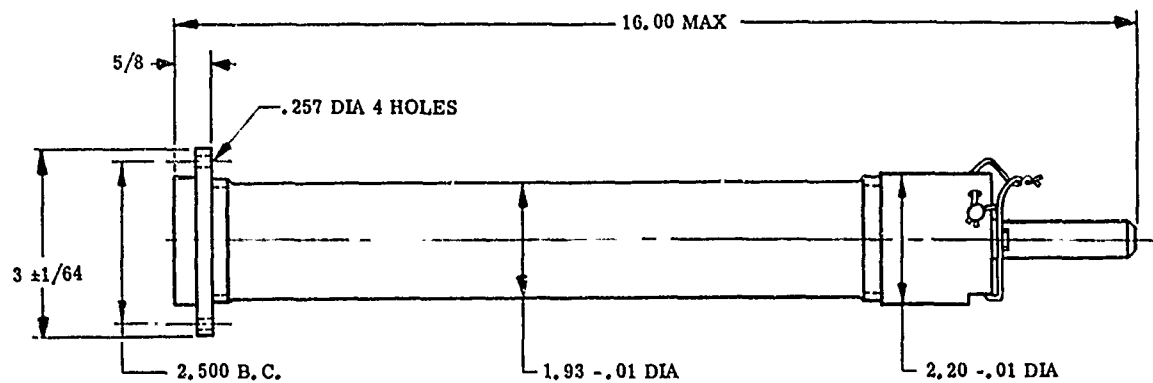


This thruster is a cartridge actuated device used, in pairs, to remove the F104 aircraft canopy.

REMOVERS

The remover is a propellant actuated device developed primarily to jettison the canopies from aircraft prior to emergency personnel ejection.

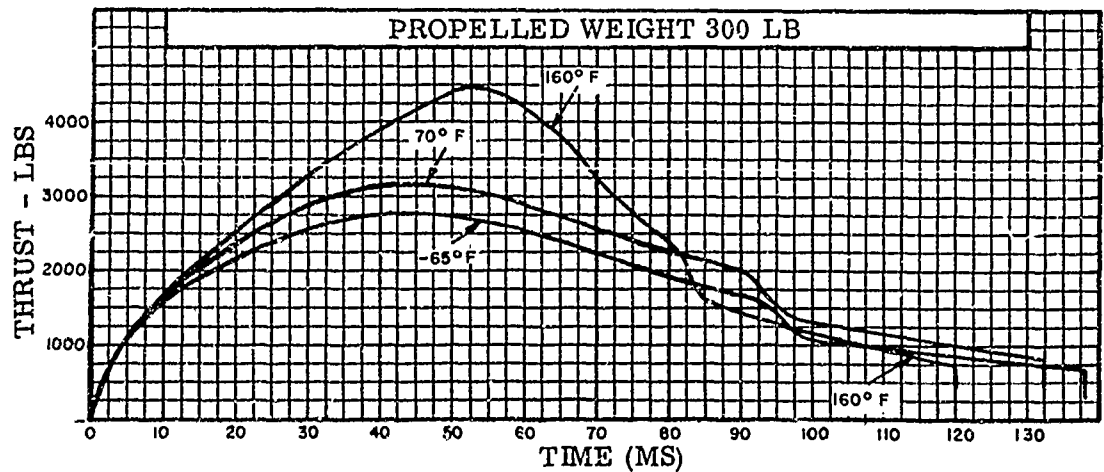
REMOVER, AIRCRAFT CANOPY, M1A3



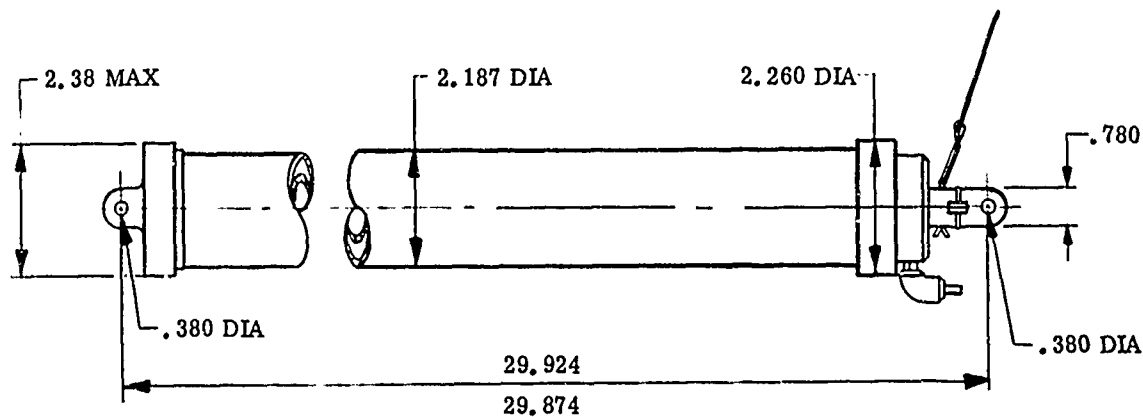
DATA

1. Stroke	23.3 in.
2. Weight (total assy)	2.1 lbs.
3. Propelled Weight	300 lbs.
4. Temperature Limits	-65°F to +200°F
5. Velocity, min. (at 70°F)	20.0 fps.
6. Thrust, min (at 70°F)	2800 lbs.
7. Stroke Time (at 70°F)	0.135 sec.
8. Firing Method	Gas Actuation of the M1A1 Firing Pin Release, which releases M1A3 Remover Firing Pin

TYPICAL PERFORMANCE



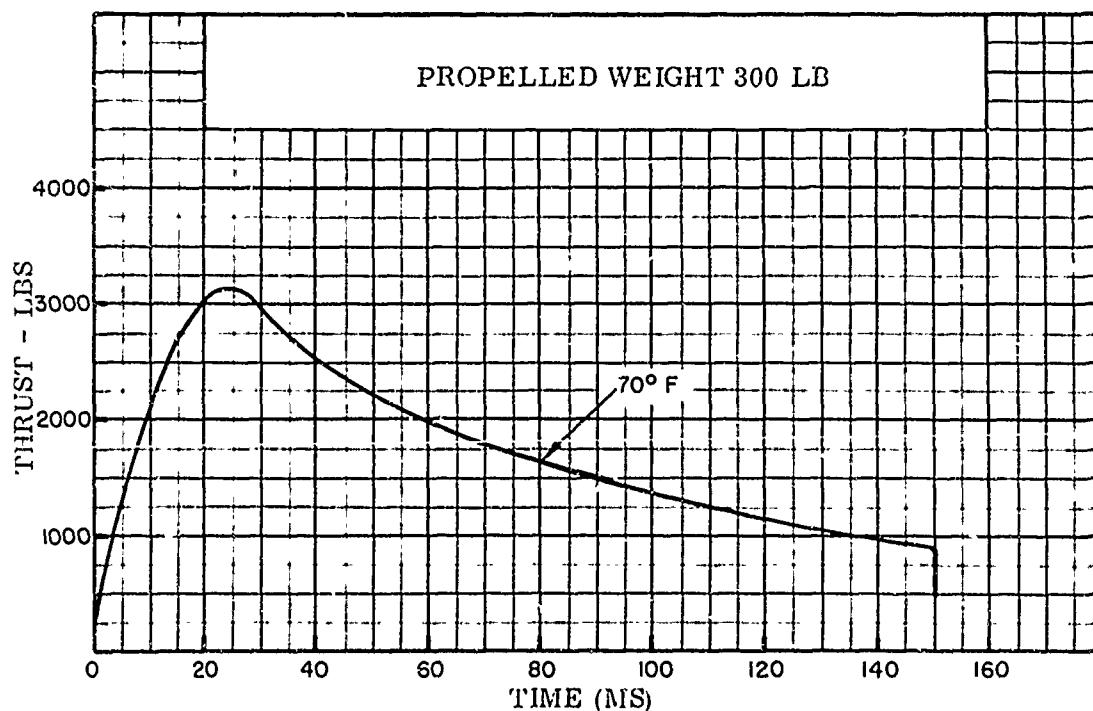
REMOVER, AIRCRAFT CANOPY, M2A1



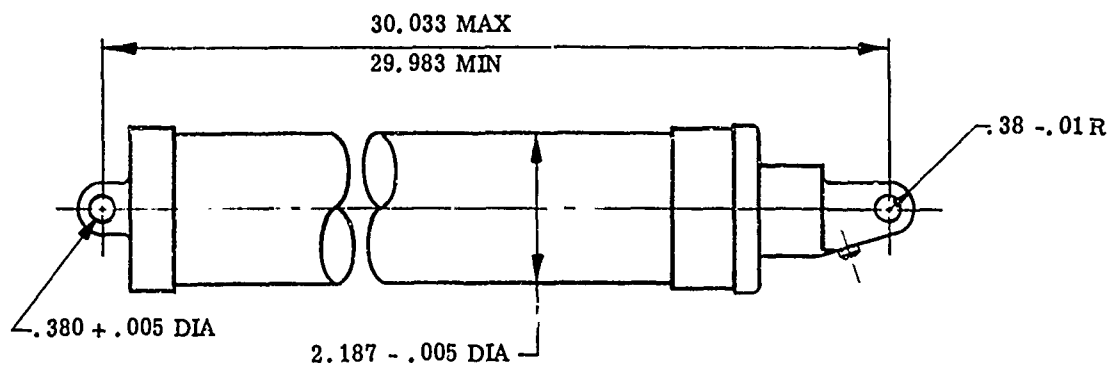
DATA

1. Stroke	26.0 in.
2. Weight	4.4 lbs.
3. Propelled Weight	300 lbs.
4. Temperature Limits	-65° F to 200° F
5. Velocity, min. (at 70° F)	20.5 fps.
6. Thrust, min. (at 70° F)	2600 lbs.
7. Stroke Time (at 70° F)	0.150 sec.
8. Firing Method	Mechanical

TYPICAL PERFORMANCE



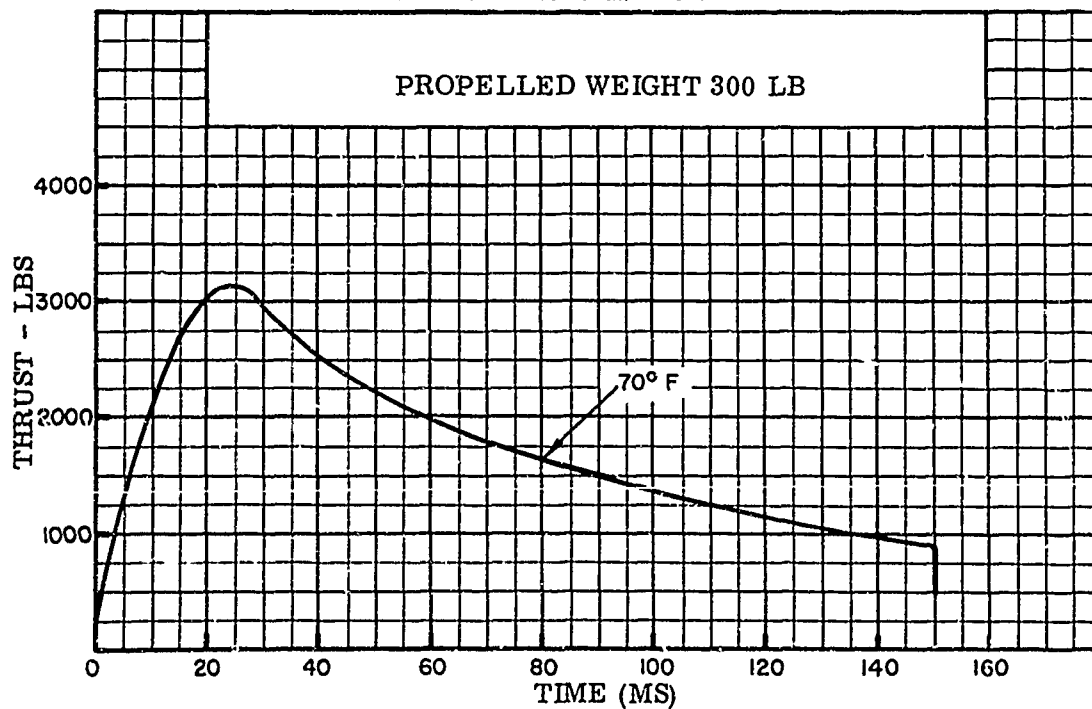
REMOVER, AIRCRAFT CANOPY, M3A1



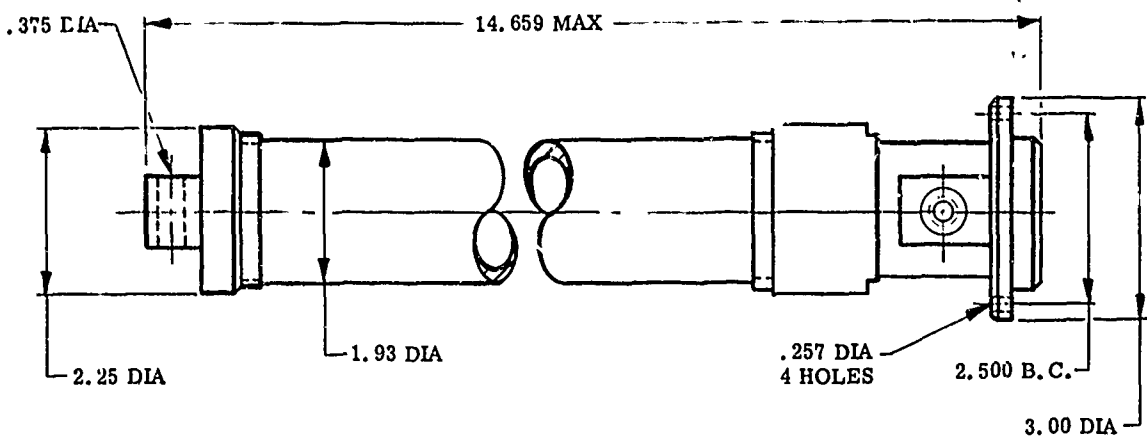
DATA

1. Stroke 26.0 in.
2. Weight (total assy) 4.4 lbs.
3. Propelled Weight 300 lbs.
4. Temperature Limits -65°F to +200°F
5. Velocity, min (at 70°F) 20.5 fps.
6. Thrust, min (at 70°F) 2600 lbs.
7. Stroke Time (at 70°F) 0.150 sec.
8. Firing Method Gas

TYPICAL PERFORMANCE



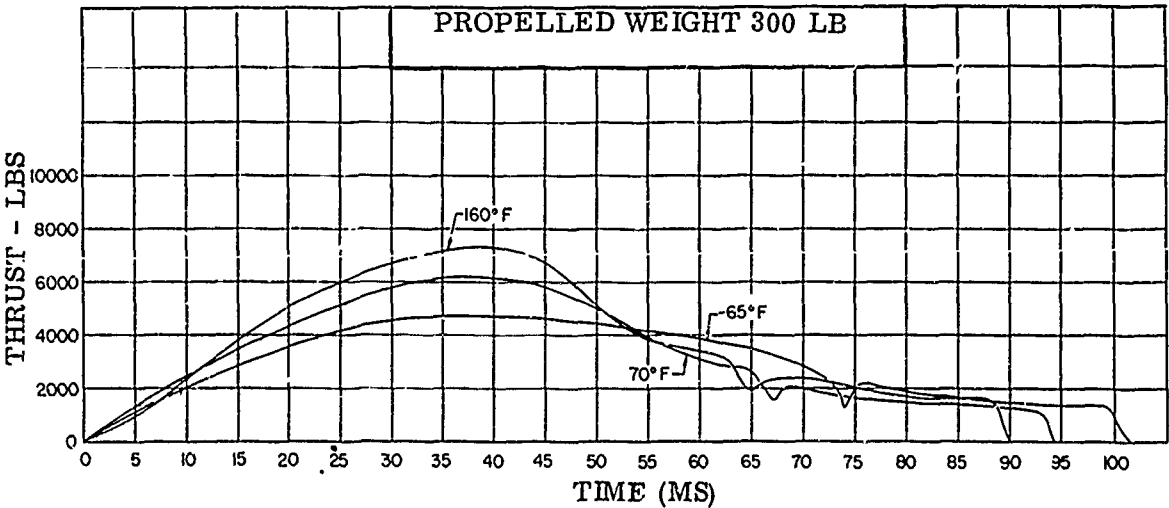
REMOVER, AIRCRAFT CANOPY, M4



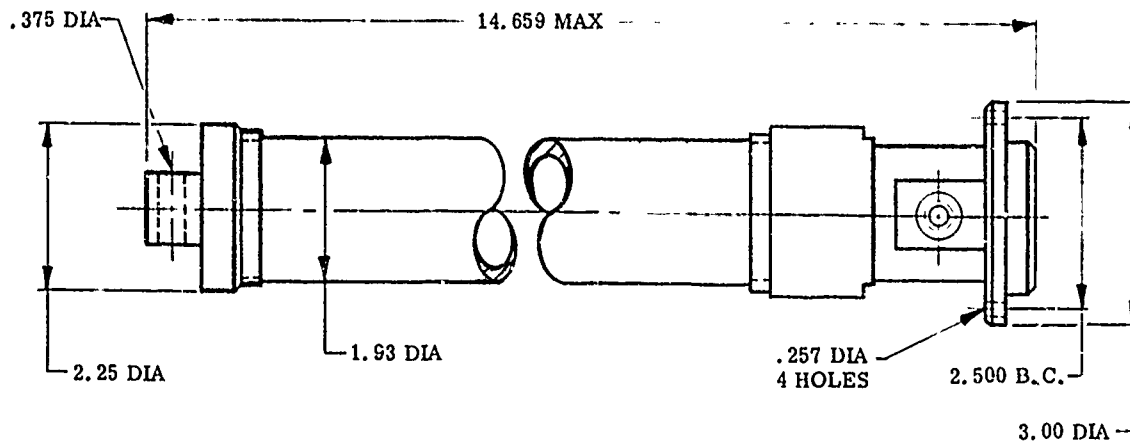
DATA

1. Stroke	19.0 in.
2. Weight (total assy.)	3.84 lbs.
3. Propelled Weight	300 lbs.
4. Temperature Limits	-65° F to +200° F
5. Velocity, min (at 70° F)	20 fps.
6. Thrust, min (at 70° F)	2800 lbs.
7. Stroke Time (at 70° F)	0.114 sec.
8. Firing Method	Gas

TYPICAL PERFORMANCE



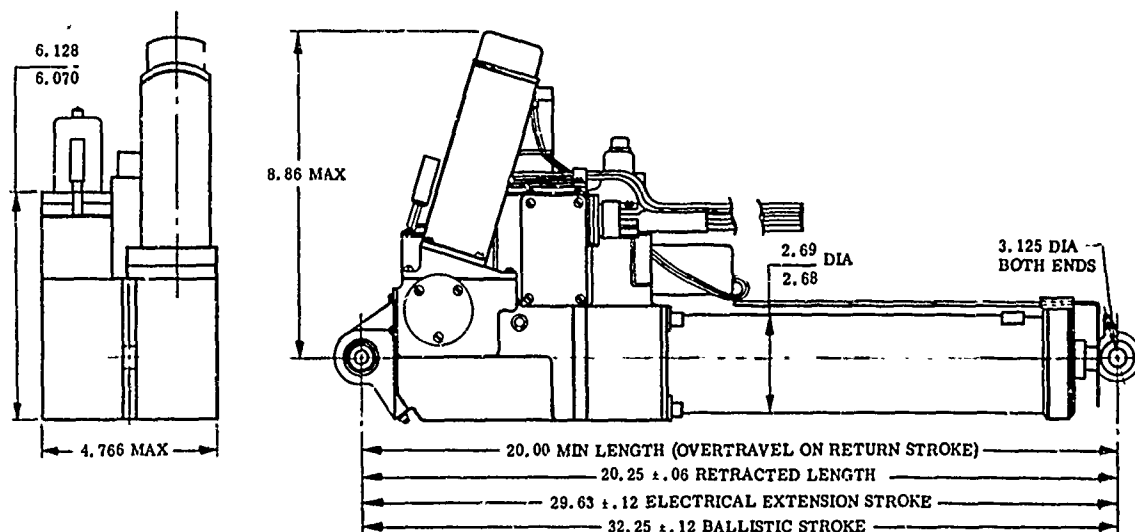
REMOVER, AIRCRAFT CANOPY, M5



DATA

1. Stroke	19.0 in.
2. Weight (total assy)	3.84 lbs.
3. Propelled Weight	1000 lbs.
4. Temperature Limits	-65° F to +200° F
5. Velocity, min (at 70° F)	10 fps.
6. Thrust, min (at 70° F)	4500 lbs.
7. Firing method	Gas

REMOVER, AIRCRAFT CANOPY, M8



DATA

1. Weight (Total Assy) 22.5 lbs.
2. Temperature Limits -65°F to +200°F

ELECTRO-MECHANICAL

1. Electric Power 28 Volt D.C. System
2. Operating Voltage Limit 18 to 29 Volts
3. Operating Loads
 - Overload 250 lbs. (tension) to 680 lbs. (compression)
 - Normal Load. 380 lbs. (compression)
 - Overload 430 lbs (tension) to 940 lbs. (tension)
4. Extension or Retraction Time 15 sec. max; 5 sec. min.
5. Clutch Engage Time, max. 0.500 sec.
6. Clutch Disengage Time, max. 0.500 sec.
7. Cinch-Down Load 1000 to 1450 lbs.
8. Stroke 8.38 to 9.38 in.

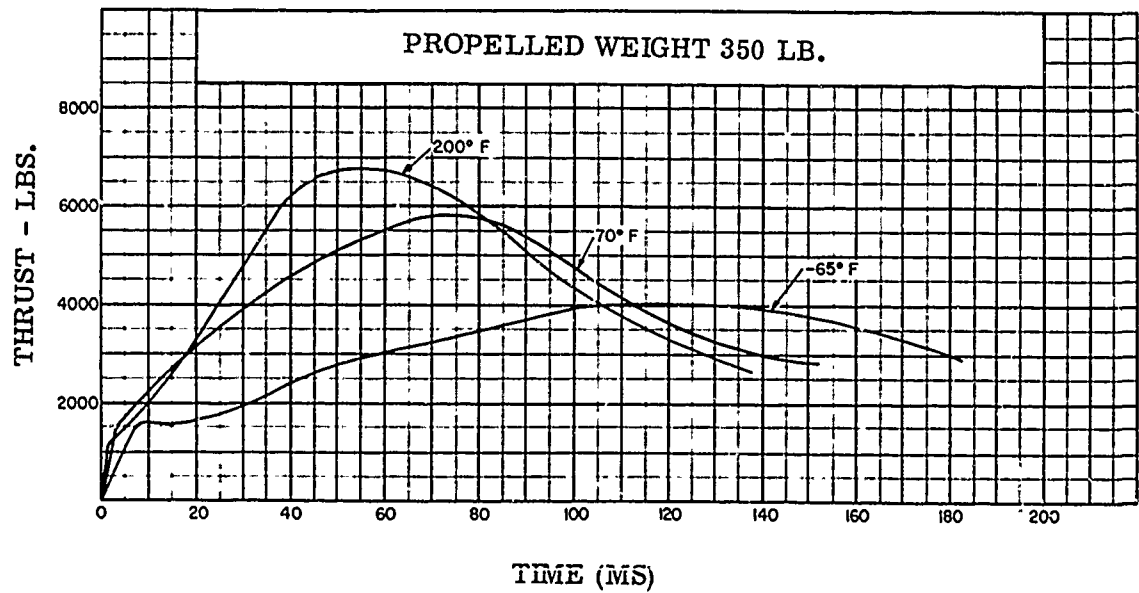
The M8 Remover combines a unique electro-mechanical means for a normal canopy operation with a ballistic charge for emergency jettisoning.

REMOVER, AIRCRAFT CANOPY, M8 (Cont'd)

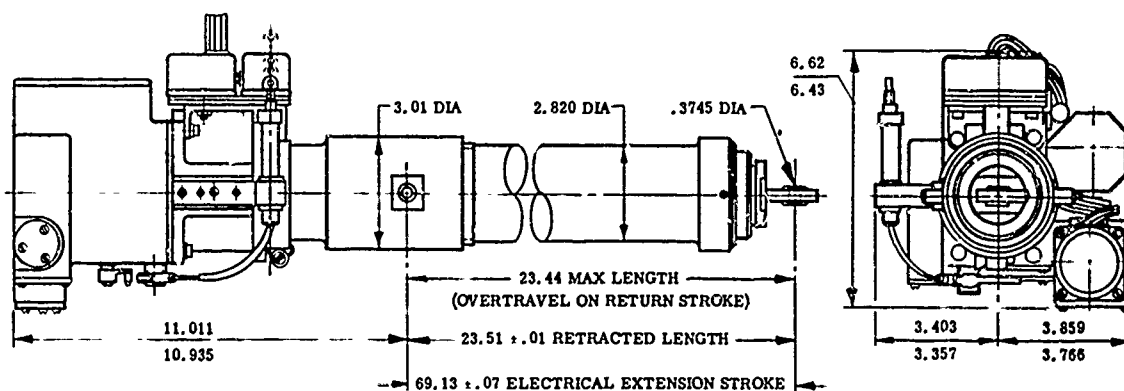
BALLISTIC

- 1. Stroke 12.0 in.
- 2. Propelled Weight 350 lbs.
- 3. Velocity min. (at 70°F) 24.0 fps.
- 4. Peak Thrust (at 70°F) 5400 lbs.
- 5. Firing Method Gas
- 6. Stroke Time (at 70°F) 0.150 sec.

TYPICAL PERFORMANCE



REMOVER, AIRCRAFT CANOPY, M9



DATA

1. Weight (Total Assy) 35 lbs.
2. Temperature Limits -65° F to +200° F

ELECTRO-MECHANICAL

1. Electric Power 28 Volt D.C. System
2. Operating Voltage Limit 18 to 29 Volts
3. Operating Loads
 - Overload 315 lbs. (compression) to 398 lbs. (compression)
 - Normal Load 288 lbs. (compression) to 228 lbs. (compression)
 - Overload 196 lbs (tension) to 142 lbs. (tension)
4. Extension or Retraction Time 20 sec. max; 10 sec. min.
5. Clutch Disengage Load 7 to 11 lbs.
6. Cinch-Down Load 400 to 500 lbs.
7. Stroke 45.86 in.

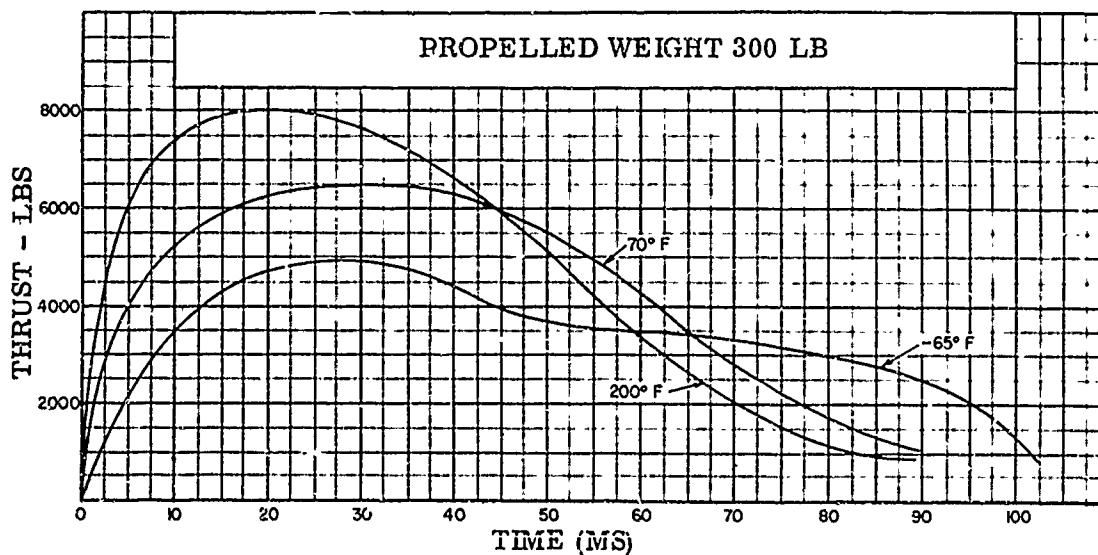
The M9 Remover combines a unique electro-mechanical means for a normal canopy operation with a ballistic charge for emergency jettisoning.

REMOVER, AIRCRAFT CANOPY, M9 (Cont'd)

BALLISTIC

1. Stroke 27.0 in.
2. Propelled Weight 300 lbs.
3. Velocity, minimum (at 70°F) 33.0 fps.
4. Peak Thrust (at 70°F) 6000 lbs.
5. Firing Method Gas
6. Stroke Time (at 70°F) 0.090 sec.

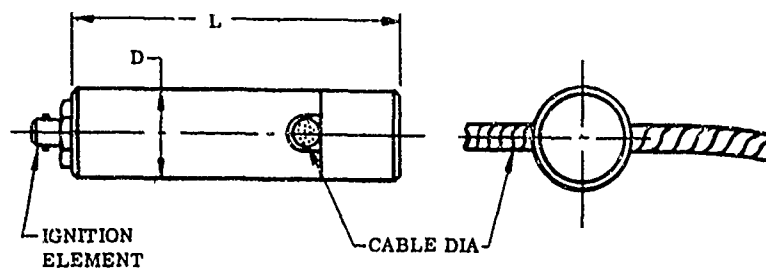
TYPICAL PERFORMANCE



CUTTER

The cutter is a propellant actuated device principally developed to cut or sever either a bundle of electrical coaxial cables, electrical wires, nylon reefing line, wire rope, rod, pipe and similar items. Cutters are classified in accordance with the following characteristics: (1) Method of Actuation - mechanical or gas pressure, and (2) Function Time - nondelay or delay.

CUTTER (For Use As Specified In Table Below)



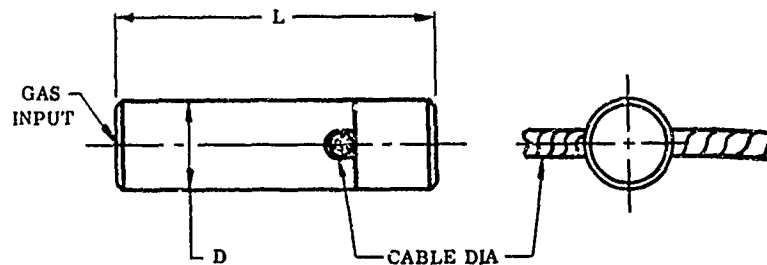
DESIGNATION	IGNITION ELEMENT UTILIZED	ASSEMBLED WEIGHT (oz.)	CABLE DIA. (in.)	LENGTH L (in.)	DIA. D (in.)
XM6	M55	1.12	3/16	2-5/16	11/16
XM20	M21	1.12	3/16	2-5/16	11/16

DATA

1. Operating Temperature Limits -65° F. to +200° F.
2. Firing Method Electric Ignition Element

These cutters are electrically initiated devices designed to cut wire rope, rod, pipe and similar items. They are also suitable for use under water.

CUTTER (For Use As Specified In Table Below)



DESIGNATION	ASSEMBLED WEIGHT (oz.)	CABLE DIA. (in.)	LENGTH L (in.)	DIA. D (in.)
XM7	1.12	3/16	2-5/16	11/16

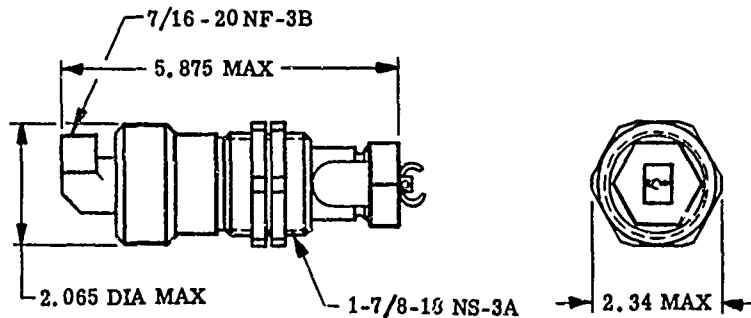
DATA

1. Operating Temperature Limits -65°F. to +200°F.
2. Firing Method Gas*

*Equivalent (3500 psi-advisory) to that delivered by an M27 type initiator.

These cutters are actuated by gas from another cartridge actuated device and designed to cut wire rope, rod, pipe and similar items. They are also suitable for use under water.

CUTTER, M8

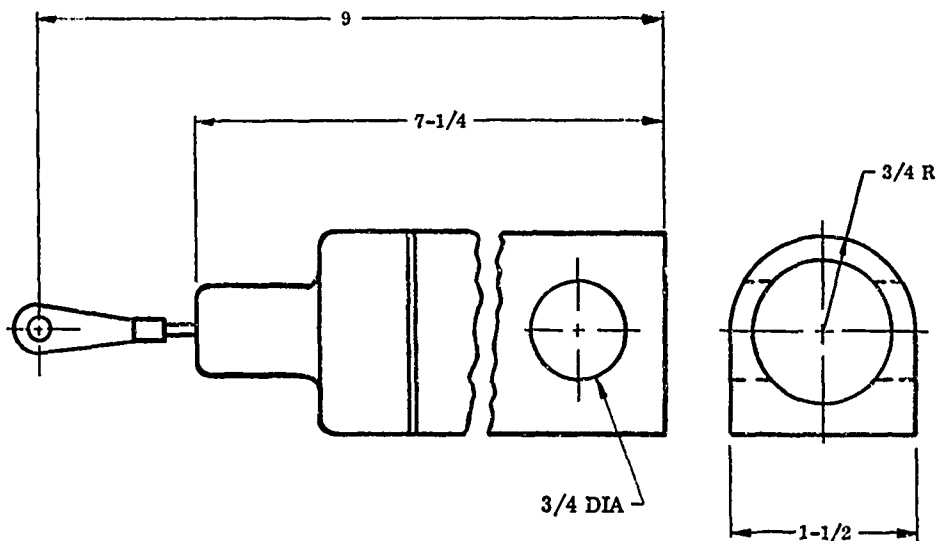


DATA

1. Stroke	1.25 inches
2. Assembled Weight . . . . .	.75 lbs.
3. Blades average depth of penetration into anvil when fired at 70° F . . . . .	.004 inches
4. Firing Method	Gas
5. Temperature Limits	-65° F to +200° F
6. Material Severed:	
Cable Assembly . . . . .	.060 inch thick vinyl sheath around 9 RG-62 A/U Coax Cables (MIL-C-17/30)
Wire Bundle . . . . .	.060 inch thick vinyl sheath around 27 strands #22 wire (MIL-W-8777) 6 strands #18 wire (MIL-W-8777) 8 strands #20 wire (MIL-W-12349)

The M8 Cutter is a cartridge actuated device designed to sever either a bundle of electrical coaxial cables or electrical wires. The blade of the cutter is coated to prevent shorting as the blade passes through the cables or wires. The M8 Cutter is installed on the F-106B aircraft and the part number is 10520566.

CUTTER, REEFING LINE (For Use As Specified In Table Below)



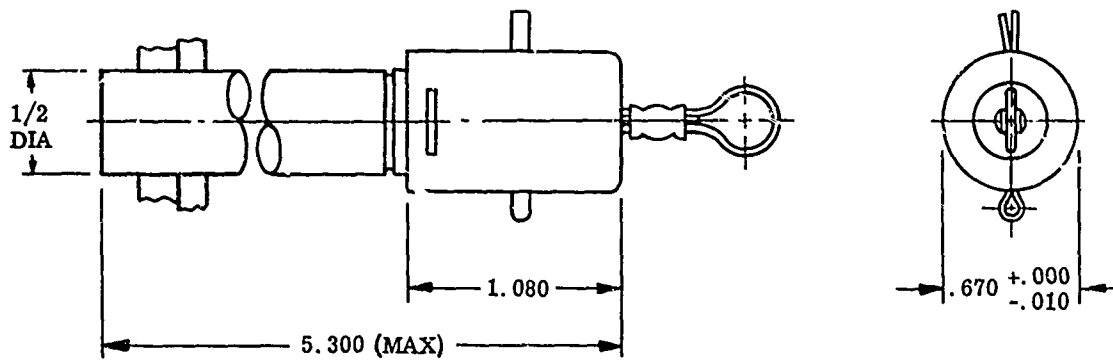
DESIGNATION	CARTRIDGE, DELAY	FUNCTION, TIME
XM-14	XM-134	1 sec.
XM-15	XM-135	2 sec.
XM-16	XM-136	4 sec.
XM-17	XM-137	6 sec.
XM-18	XM-138	8 sec.
XM-19	XM-139	10 sec.

DATA

1. Weight of Assembly 0.9 lb.
2. Operating Temperature Limits -90° F to 200° F

These cutters are designed to sever 2 strands of 6000 lb. test nylon reefing line.

**CUTTER, CARTRIDGE ACTUATED, FOR USE WITH CARTRIDGE, DELAY,
AS SPECIFIED IN TABLE BELOW**



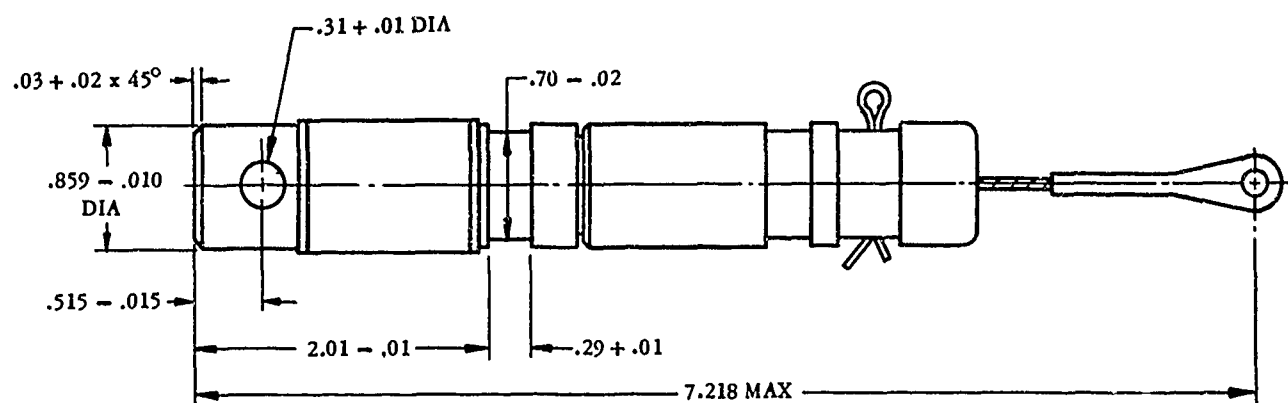
DESIGNATION CUTTER, CARTRIDGE ACTUATED	CARTRIDGE, DELAY	FUNCTION, TIME
XM-26	XM-234	2 SEC
XM-27	XM-235	4 SEC
XM-28	XM-236	6 SEC
XM-29	XM-237	8 SEC
XM-30	XM-238	10 SEC

DATA

1. Weight of Assembly 0.1 lb.
2. Operating Temperature Limits -90° F. to +200° F.

These cutters are designed to sever 2 strands of 1000 lb. test nylon reefing line.

CUTTERS, CABLE/REEFING LINE WITH CARTRIDGE, DELAY



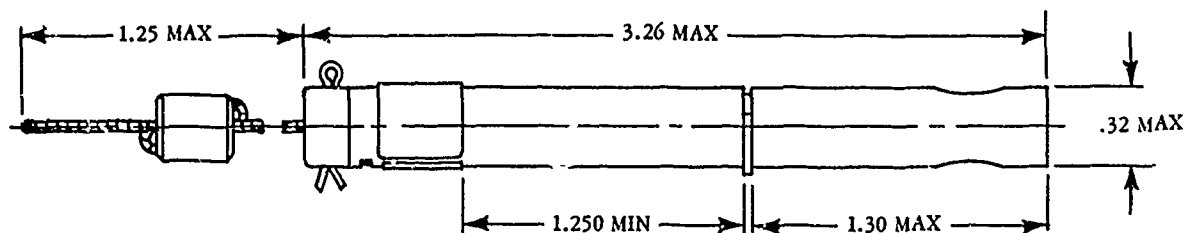
DESIGNATION	CARTRIDGE, DELAY	FUNCTION TIME
M9	XM129	2 SEC
XM10	XM130	4 SEC
XM11	XM131	6 SEC
XM12	XM132	8 SEC
M13	XM133	10 SEC

DATA

- 1. Assembly Weight 4.0 Ounces
- 2. Temperature Limits. $-95^\circ\text{ F to } + 250^\circ\text{ F}$
- 3. Firing Method Mechanical
- 4. Shock 750 g
- 5. Acceleration 400 g
- 6. Material Severed Two 1/2-inch 1000 lb tubular nylon lines

The M9 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of an M129 Delay Cartridge which is fired mechanically by applying a force to a cable or lanyard.

CUTTER, REEFING LINE, XM24

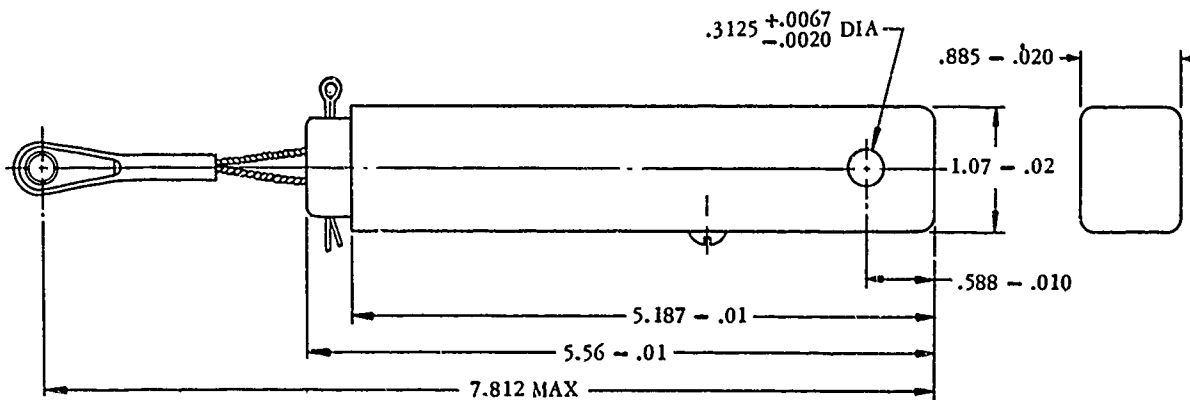


DATA

1. Assembly Weight 2.5 oz.
2. Operating Temperature Limits -65°F to 200°F
3. Firing Method Mechanical
4. Time Delay 2 seconds
5. Material Severed One 1000 lb. nylon line

This unit was developed for use in initiating timely disreefing of the main recovery chute used with the B58 capsule escape systems.

CUTTER, DELAY, M22

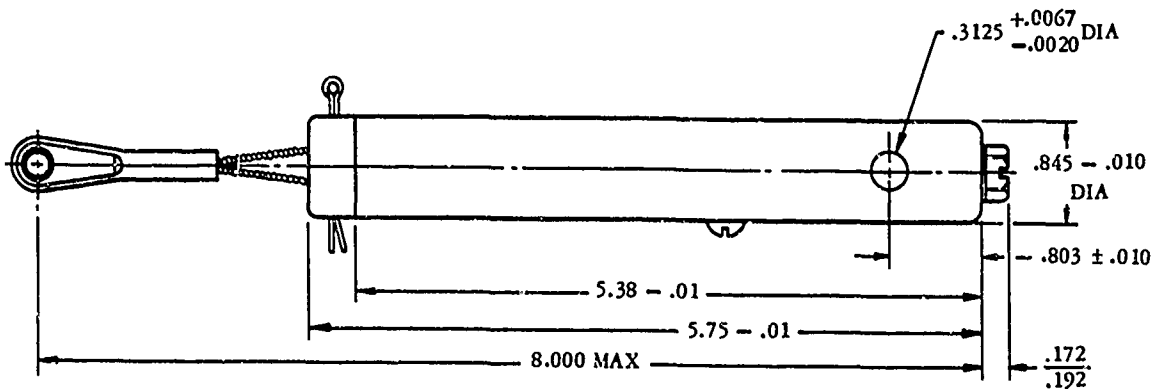


DATA

1. Assembly weight 4.5 ounces
2. Temperature limits -65° F to 160° F
3. Firing Method Mechanical
4. Shock. 750 g
5. Material severed Two 1/2-inch 1000 lb tubular
nylon lines
6. Delay Time 10 seconds

The M22 Cutter is a component part of an aerial delivery system for cargo and drone recovery. The purpose is to sever cords or wires, and it consists of a delay cartridge which is fired mechanically by applying a force to a lanyard.

CUTTER, DELAY, M21



DATA

1. Assembled weight 4.5 ounces
2. Temperature limits -65° F to 160° F
3. Firing Method Mechanical
4. Shock 750 g
5. Material severed Two 1/2-inch 1000 lb tubular nylon lines
6. Delay Time 2 seconds

The M21 Cutter is a component part of an aerial delivery system for cargo and drone recovery. The purpose is to sever cords or wires and it consists of a delay cartridge which is fired mechanically by applying a force to a lanyard.

MILD DETONATING CORD SYSTEM

There are four basic methods that could be used to transfer the primary initiation stimulus to each PAD associated with any given system. They are mechanical, gas, electric and explosive. Usually a combination of two or more of the methods are used in a system. This is a description of a mechanically initiated explosive system.

The explosive system utilizes Mild Detonating Cord (MDC) completely confined. The MDC consists of one grain of PETN per linear foot contained on a 0.040 inch diameter flexible lead tubing. The tubing is covered with layers of fabric and plastic material sufficient to dampen and completely contain the resulting products of detonation of the explosive. In addition to resisting rupture, the cord has the advantages of being highly flexible, can readily be coiled in a 1-1/2 inch radius, is resistant to abrasion, and is light weight (0.03 pound per foot). The MDC has an outside diameter of approximately 0.25 inch and a detonating velocity of approximately 23,000 feet per second.

Since MDC is unique, both as to its construction and its physical properties, it does not lend itself to standard assembly methods. The system assembly problem was solved by designing special hardware around the core and covering for the specific purpose of retrofitting existing electrical or gas systems or for new systems.

MDC systems in various types of confining structures are being widely used in such applications as initiating explosive bolts or nuts to release points of attachments, initiating flexible linear shape charge systems for severing attachment structures such as aircraft fuselages, port covers, cutting motor cases, as well as for functioning the various PAD in Aircraft Crew Emergency Escape Systems.

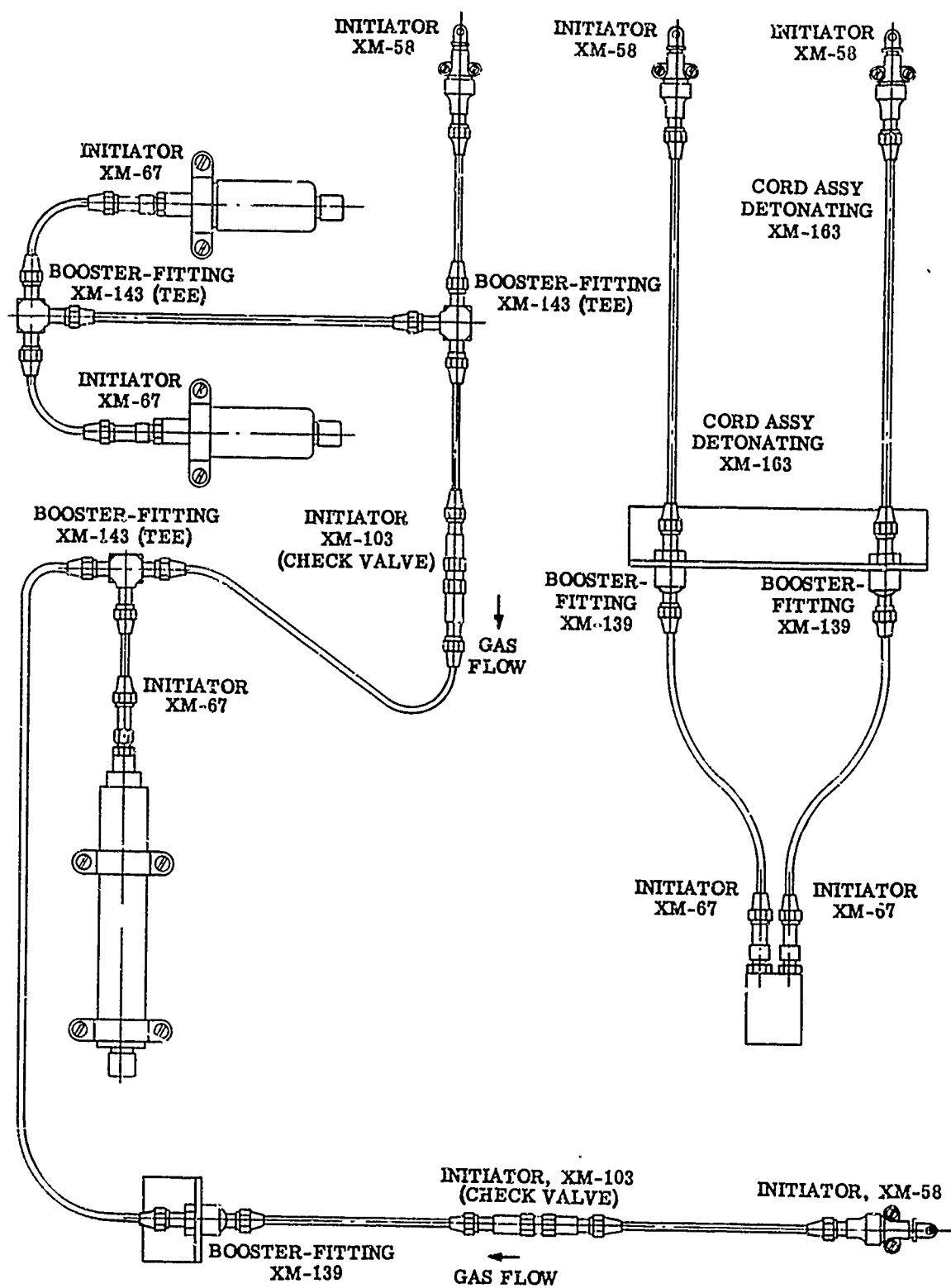
Special MDC hardware has been designed and tested consisting of initiators, time delays, check valves, quick disconnects, and crossover stimulus transfer fittings. Data sheets on these components are included in this section. A simulated prototype system embodying those functions normally expected in an aircraft escape system is illustrated in Figure 1.

The sequence of operation is started by activating the ejection initiators. One initiator actuates the canopy remover and simultaneously activates the thermal batteries that supply electrical energy to operate the stabilization fins of the capsule. The other two ejection initiators actuate two gas producing initiators generating sufficient gas pressure to fire the delay cartridge which functions the ejection catapult. The canopy may be removed in an emergency by operating the initiator located near the exterior of the aircraft with a lanyard handle located in an access panel outside the aircraft. A check valve prevents the actuation of the thermal batteries. The quick disconnects separate the MDF lines so that the capsule is free of exterior restraints.

The systems are operable over the temperature range of -65°F. to $+200^{\circ}\text{F.}$

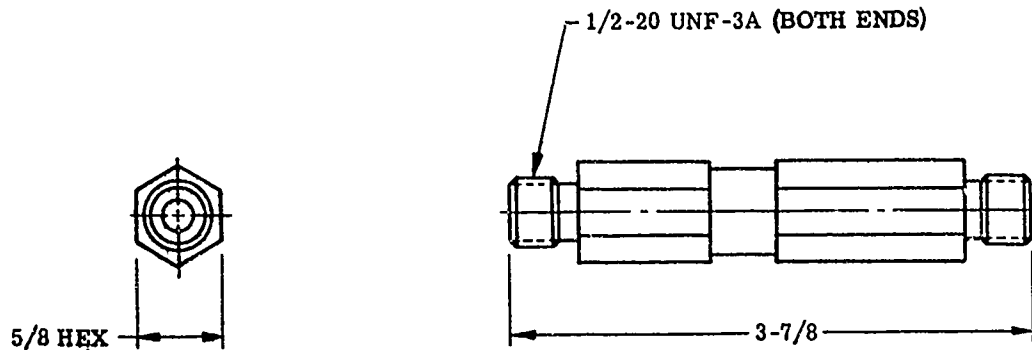
MILD DETONATING CORD

A data sheet of each MDC is presented and a typical MDC actuated ejection system is also illustrated.



MDC ACTUATED EJECTION SYSTEM

INITIATOR, CARTRIDGE ACTUATED, 2-WAY DELAY (MDC)

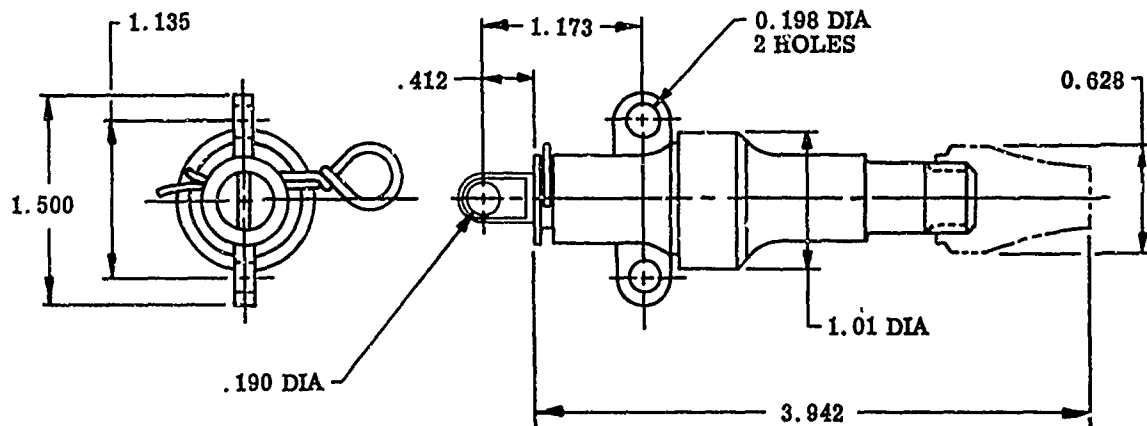


DATA

1. Weight of Assembly 0.100 lb.
2. Function Time As Required
3. Operating Temperature Limits -65° F. to +200° F.

This Initiator is a device designed to contain a delay element which interrupts the detonating stimulus for a specified time and then initiates the continuation of the stimulus to any desired component. It will function regardless of which end receives the initial stimulus.

INITIATOR, CARTRIDGE ACTUATED, XM-58 (MECHANICAL)

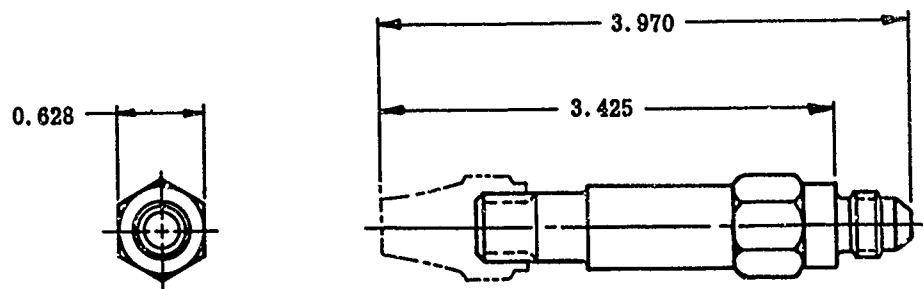


DATA

1. Weight of Assembly 0.131 lb.
2. Operating Temperature Limits -65° F. to +200° F.

This initiator is a device actuated by a pull of from 25 to 35 pounds force. When actuated the output of the initiator is a shock wave of sufficient brisance to detonate the acceptor charge of MDC, thus initiating the transmission of the detonating stimulus.

INITIATOR, CARTRIDGE ACTUATED, XM-59 (GAS)

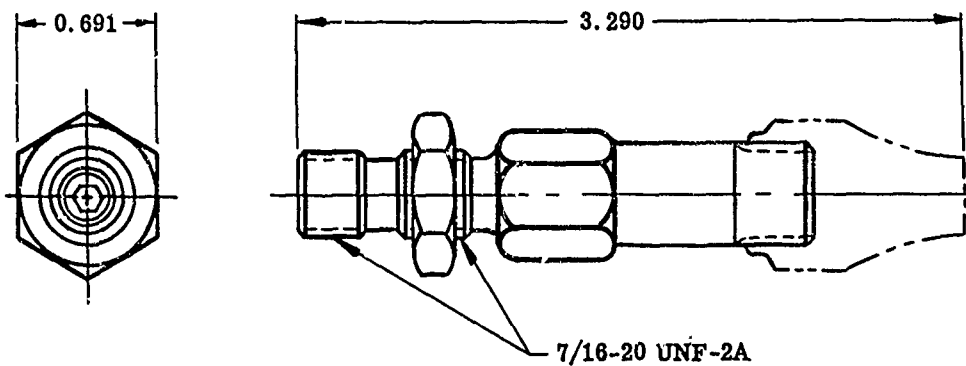


DATA

1. Weight of Assembly 0.076 lb.
2. Operating Temperature Limits -65° F. to +200° F.

This initiator is actuated by a minimum of 500 p.s.i. of gas pressure. When actuated the output of the initiator is a shock wave of sufficient brisance to detonate the acceptor charge of MDC, thus initiating the transmission of the detonating stimulus.

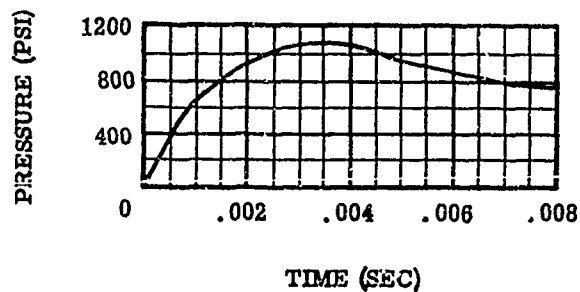
INITIATOR, CARTRIDGE ACTUATED, XM-67



DATA

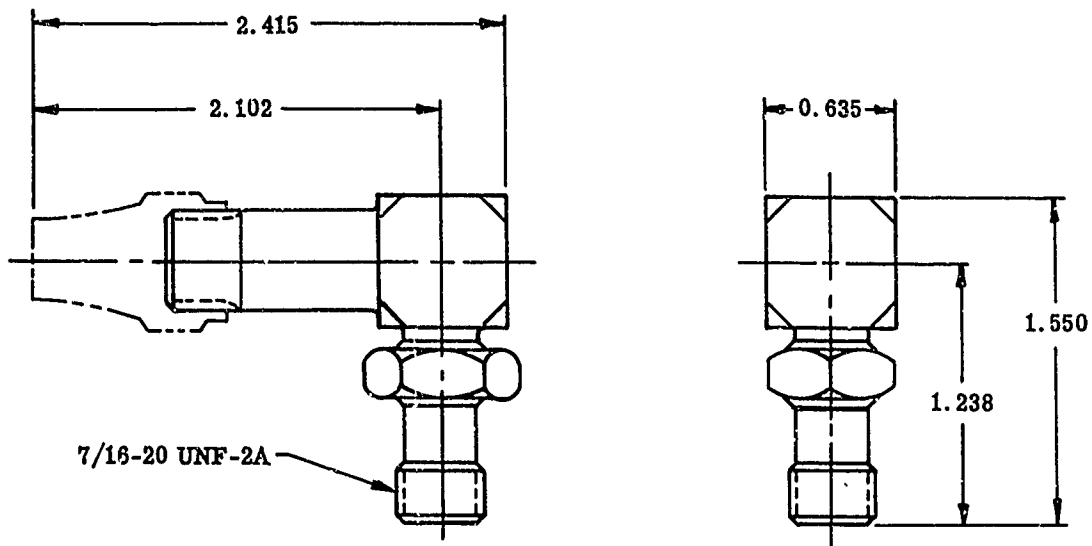
1. Weight of Assembly 0.068 lb.
2. Function Time 4 milliseconds
3. Output 1000 psi in 0.5 cu. in. volume
4. Operating Temperature Limits -65°F. to +200°F.

TYPICAL PERFORMANCE



This initiator is actuated by the shock wave from the MDC donor charge. The output end is threaded so that it can mate with any standard gas actuated pad.

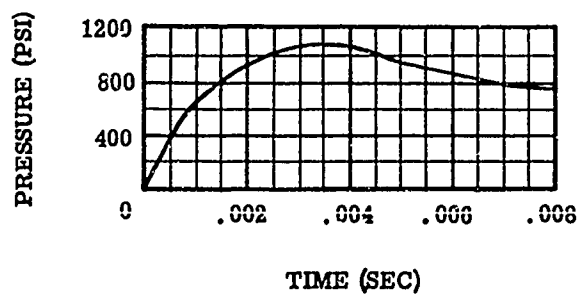
INITIATOR, CARTRIDGE ACTUATED, XM-69



DATA

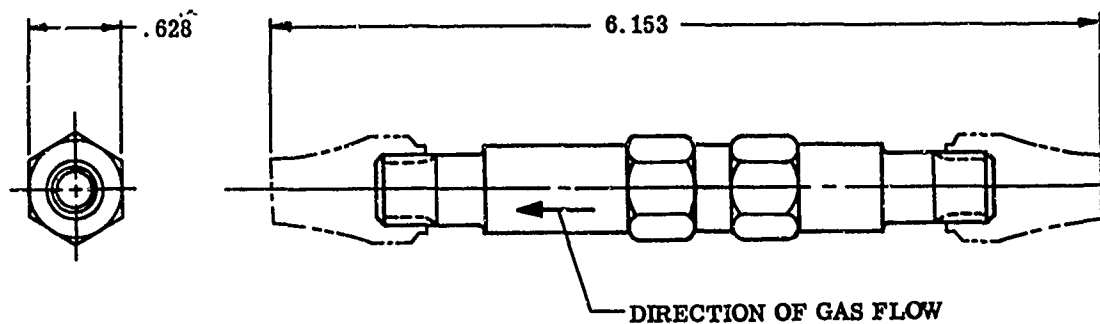
1. Weight of Assembly..... 0.070 lb.
2. Function Time 4 milliseconds
3. Operating Temperature Limits -65°F. to +200°F.

TYPICAL PERFORMANCE



This initiator is actuated by the shock wave from the MDC donor charge. The output end is threaded so that it can mate with any standard gas actuated pad. The MDC enters the initiator perpendicular to the center line of the outlet of the initiator.

INITIATOR, CARTRIDGE ACTUATED, XM-103 (CHECK VALVE)

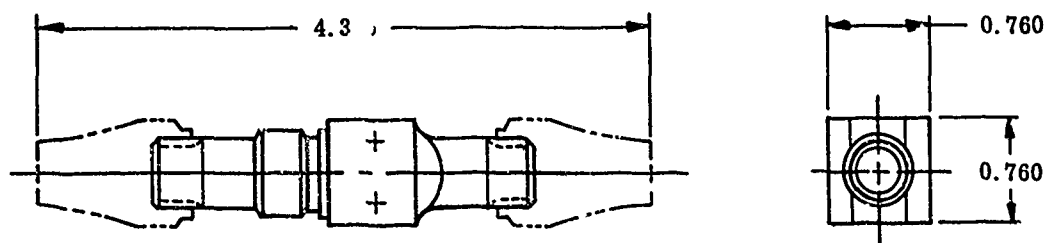


DATA

1. Weight of Assembly 0.106 lb.
2. Operating Temperature Limits -65° F. to +200° F.

This initiator is a device designed to permit the transfer of a detonating stimulus in one direction only.

BOOSTER-FITTING, PROPELLANT ACTUATED DEVICE, XM-139 (QUICK DISCONNECT)

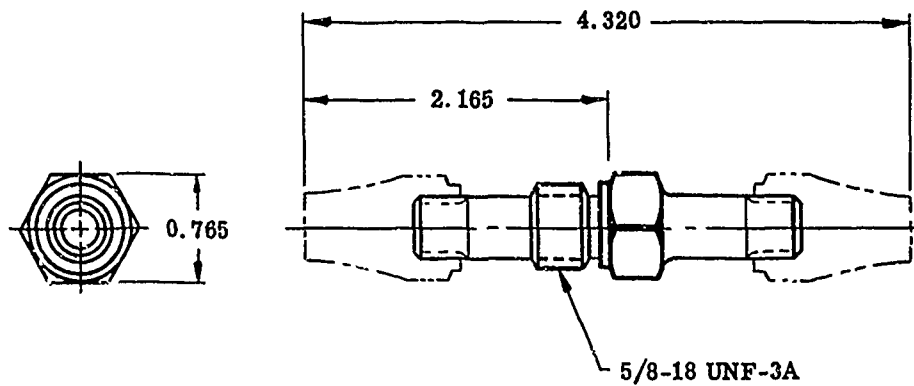


DATA

- | | |
|---|---------------------|
| 1. Weight of Assembly | 0.077 lb. |
| 2. Function Time | 50 microseconds |
| 3. Operating Temperature Limits | -100° F. to 350° F. |

This booster-fitting is a device designed to transfer a detonating stimulus thru a bulkhead and separate the transmitting lines at the bulkhead.

BOOSTER-FITTING, PROPELLANT ACTUATED DEVICE, XM-141 (UNION)

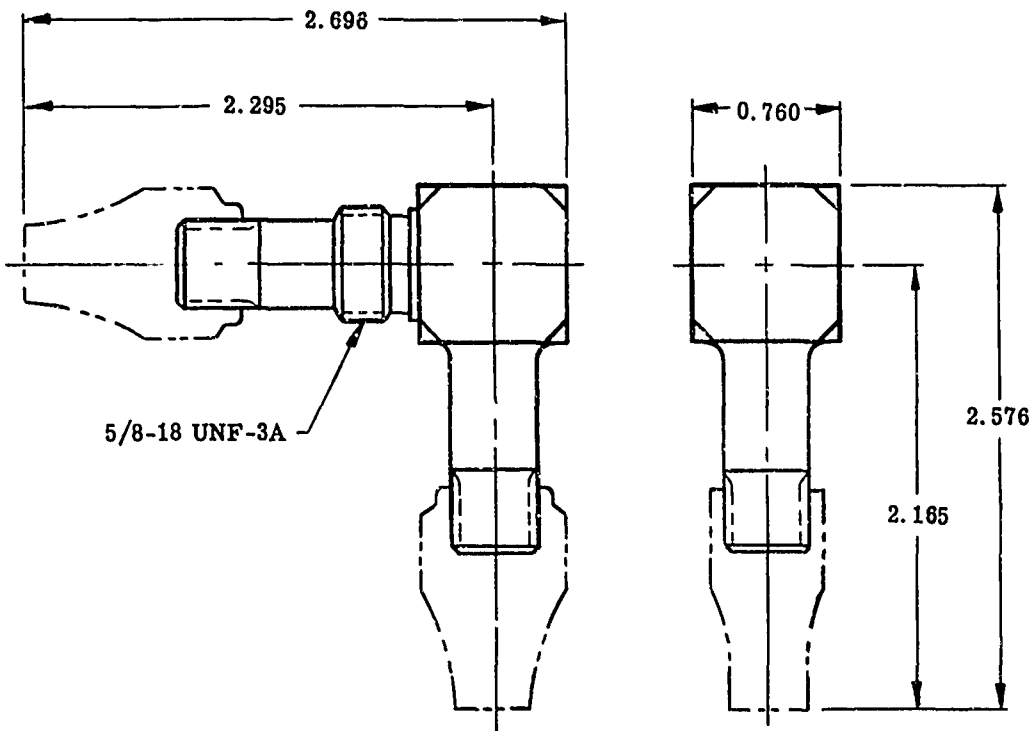


DATA

1. Weight of Assembly 0.064 lb
2. Operating Temperature Limit -100° F to +350° F

This booster-fitting is a device designed to transfer a detonating stimulus thru a bulkhead from one MDC line to another.

BOOSTER-FITTING, PROPELLANT ACTUATED DEVICE, XM-142 (90° UNION)

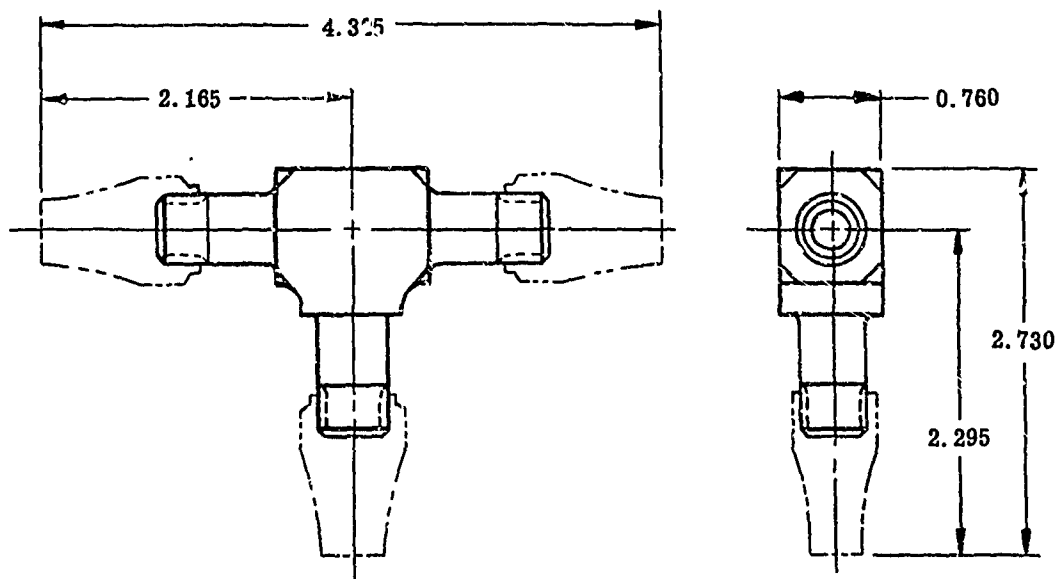


DATA

- | | |
|---|----------------------|
| 1. Weight of Assembly | 0.077 lb. |
| 2. Operating Temperature Limits | -100° F. to +350° F. |

This booster-fitting is a device designed to transfer a detonating stimulus from one MDC line to another, situated at a right angle to the donor line.

BOOSTER-FITTING, PROPELLANT ACTUATED DEVICE, XM-143 (TEE)

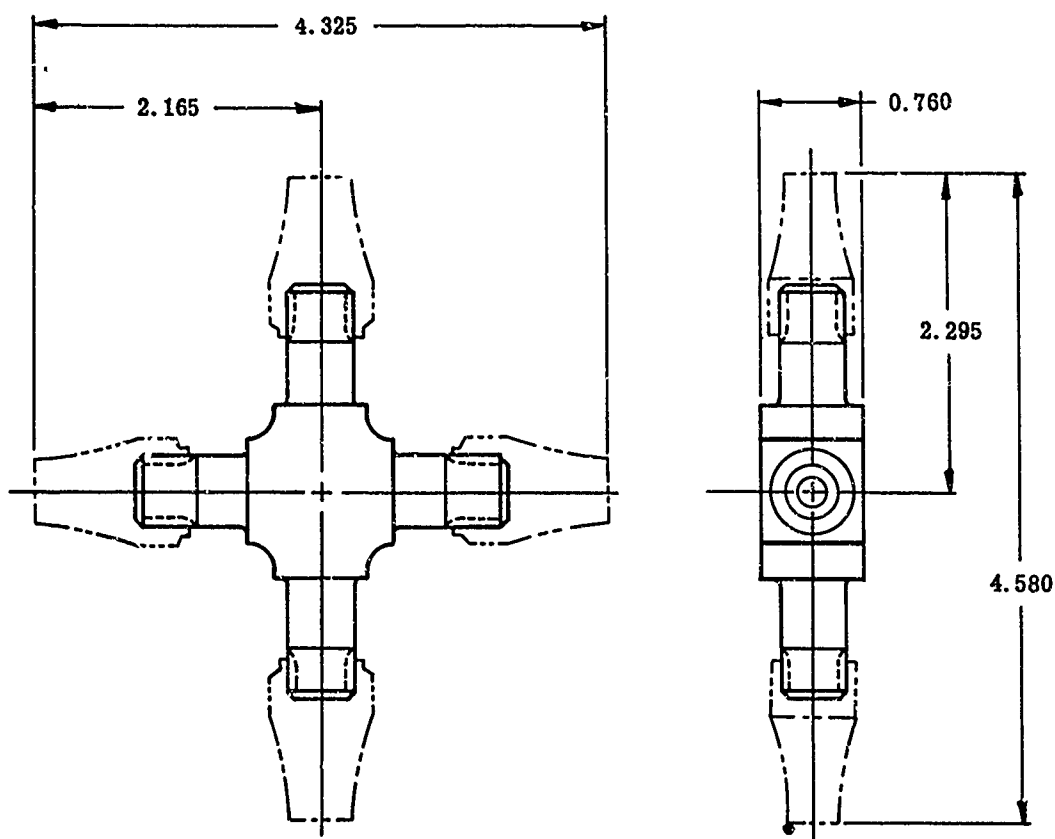


DATA

1. Weight of Assembly 0.121 lb
2. Function Time Instantaneously
3. Operating Temperature Limits -100° F. to 350° F.

This booster-fitting is a device designed to transfer a detonating stimulus from one MDC line to two others.

BOOSTER-FITTING, PROPELLANT ACTUATED DEVICE, XM-144 (CROSS)

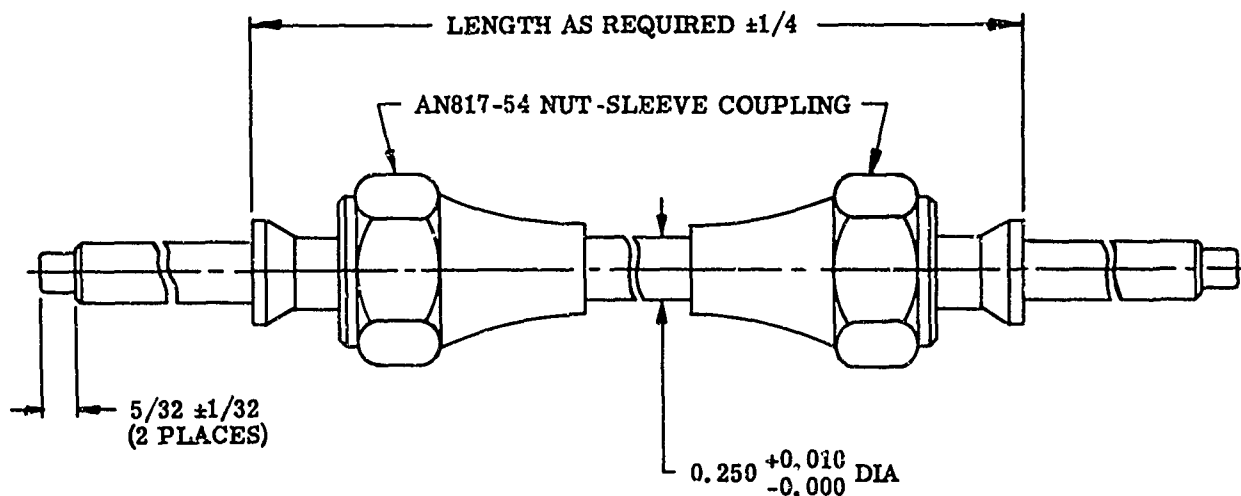


DATA

1. Weight of Assembly 0.142 lb.
2. Operating Temperature Limits -100°F. to $+350^{\circ}\text{F.}$

This booster-fitting is a device designed to transfer a detonating stimulus from one MDC line to three others.

CORD ASSEMBLY, DETONATING, XM-163



DATA

1. Weight of Assembly 0.100 for ends plus
0.0267 lb./ft of cord
2. Function Time 1n microseconds
3. Velocity Approx 21,000 ft/sec.
4. Operating Temperature Limits -100° F. to $+350^{\circ}$ F.

This cord assembly is designed to receive and transfer a detonating stimulus from one point to another.

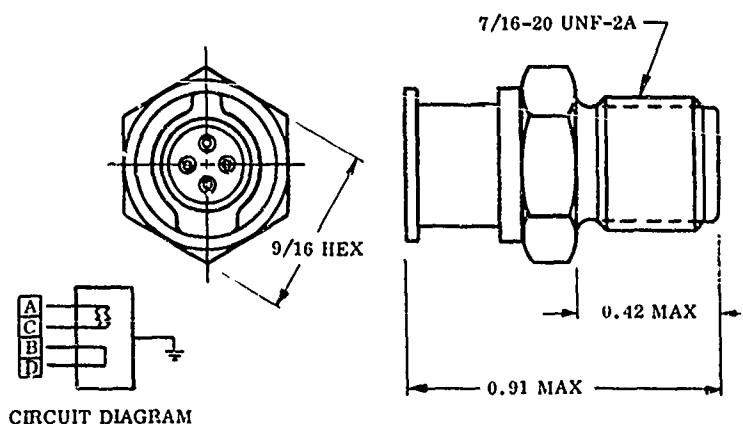
ELECTRICAL IGNITION ELEMENTS AND PULSE GENERATOR

The electrical ignition element is an item principally developed to supply gas pressure (and brisance) to operate firing mechanisms of other propellant actuated devices or initiate an explosive chain reaction of the propelling charge(s) in propellant actuated devices.

The pulse generator is a hand held device designed to generate sufficient electrical energy when squeezed manually to fire electrical ignition elements.

A data sheet for each item is presented.

IGNITION ELEMENT, ELECTRICAL (For Use As Specified In Table Below)



TWO CIRCUIT MULTIPRONG TYPE

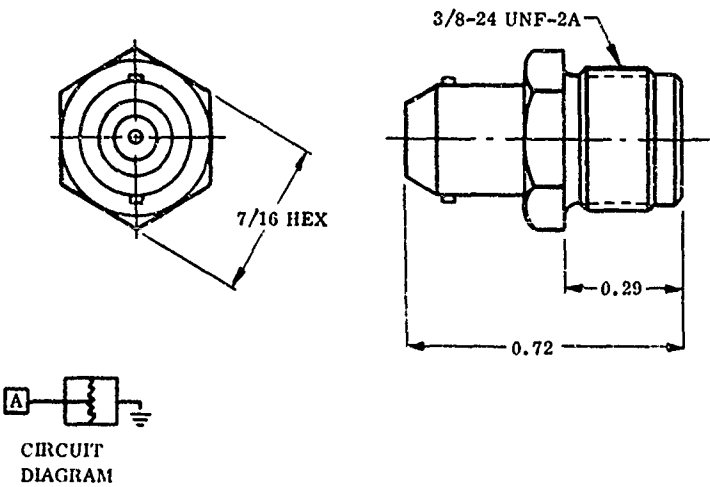
DESIGNATION	CURRENT RATING (AMP)		RECOMM'D FIRING CURRENT (amps)	BRIDGEWIRE RESISTANCE (ohm)	AVERAGE FUNCTIONING TIME (ms)	PRIMER CHARGE (mg)	BOOSTER CHARGE (mg)
	ALL-FIRE @ 18.V.	NO-FIRE @ 28.V.					
M21	3.5	1.5	5.0	0.11 ±0.03	50 a 3.5A	90. ±5.	60 ±5
XM22	3.5	1.5	5.0	0.11 ±0.03	50 a 3.5A	90. ±5.	

DATA

1. Operating Temperature Limits. -65°F. to +200°F
2. Assembled Weight (Approximately): M21, 11.5 gm; XM22, 10 gm.
3. Mates with Viking Connector VP4/ 4CE (or Equal).
4. AC is Firing Circuit; BD is Checkout Circuit.
5. The threaded section of this element will fit standard gas fittings on propellant actuated devices.
6. Output Approx. 4740 psi in 0.062 in 3 Vol. at 70°F.
7. Functioning Time using 5 amps less than 10ms.

The electrical ignition element is an item having an electrical resistance embedded in a heat combustible composition which, when ignited, generates a gas pressure to actuate a device and/or initiate an explosive chain reaction of the propelling charge(s) in propellant actuated devices.

IGNITION ELEMENT, ELECTRICAL (For Use As Specified In Table Below)



BAYBAYONET CONNECTOR TYPE (DAGE CBSN 1-317-1 OR EQUAL)

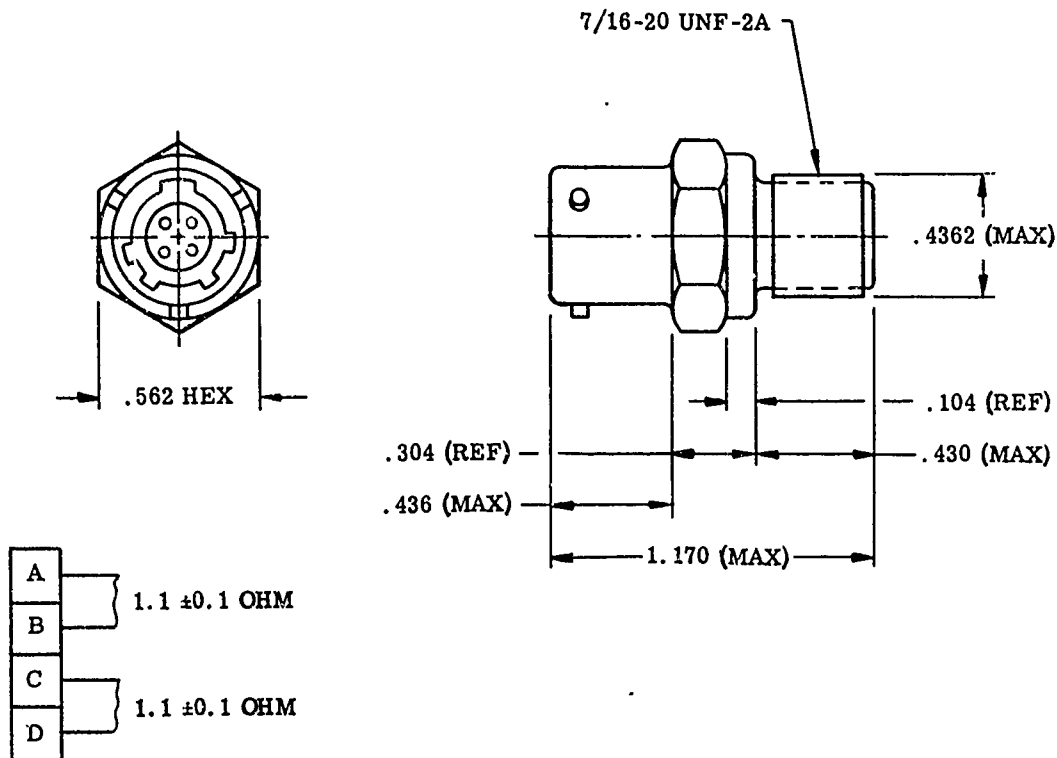
DESIGNATION	CURRENT (AMP.)		RECOMM'D FIRING CURRENT (amps)	BRIDGEWIRE RESISTANCE (ohms)	AVERAGE FUNCTIONING TIME (ms)	CHARGE WEIGHT (mg)
	ALL- FIRE @18.V.	NO- FIRE @28.V.				
M26	1.5	0.5	3.0	1.0 ±0.3	20. @ 1.5A.	90 ±5
M55	3.5	1.5	5.0	0.11 ±0.03	20. @ 5.0A	90 ±5
M56	3.5	1.5	5.0	0.11 ±0.03	20. @ 5.0A	45 ±5
M42	1.5	0.5	3.0	1.0 ±0.3	20. @ 1.5A	90 ±5

DATA

1. Operating Temperature Limits -65°F to +200°F
2. The M series output is similar to #33 percussion primer, except that the M56 output is similar to #26 percussion primer.

The electrical ignition element is an item having an electrical resistance embedded in a heat combustible composition which, when ignited, generates a gas pressure to actuate a device and/or initiate an explosive chain reaction of the propelling charge(s) in propellant actuated devices.

IGNITION ELEMENT, ELECTRICAL, M-47



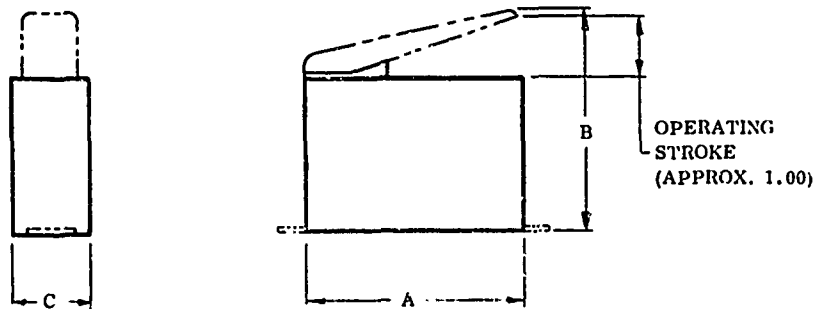
CIRCUIT DIAGRAM

DATA

1. Current Rating (amp)
 - A. Sure Fire..... 5.0
 - B. No Fire..... 1 Ampere/1watt for 5 minutes
 - C. All Fire 3.0 (50 ms.)
2. Bridge Wire Resistance 1.1 ±0.1 ohm
3. Average Time to Peak Pressure 11 ms. at 4 amp
4. Output (psi) 7000 max (measured in a
0.062 in.³ volume)
5. Charge Weight (mg.) 250 ±5
6. Booster Charge (mg.) 130 ±2
7. Weight of Assembly (gm.) 16.0
8. Operating Temperature Limits..... -65° F. to +400° F.
9. Mates with Connector MS-3116F-8-4S

This electrical ignition element is an item having an electrical resistance embedded in a heat combustible composition which, when ignited, generates a gas pressure to actuate a device and/or initiate an explosive chain reaction of the propelling charge(s) in propellant actuated devices.

PULSE GENERATOR (For Use As Specified In Table Below)



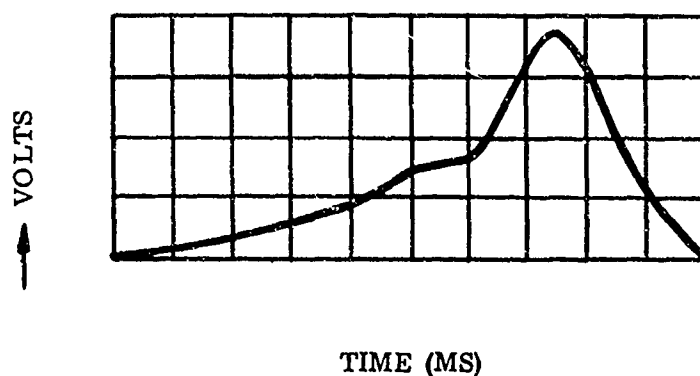
DESIGNATION	MINIMUM OUTPUT ENERGY (mws)	INTERNAL RESISTANCE (ohm)	OPERATING LOAD (lbs.)	ASSEMBLED WEIGHT (lbs.)	A (in.)	B (in.)	C (in.)
M10	90.	0.3	20.	1.8	3.88	3.50	1.88
M11	160.	0.5	35.	1.6	4.00	3.50	1.75
M15	90.	1.4	20.	1.9	3.88	3.50	1.88

DATA

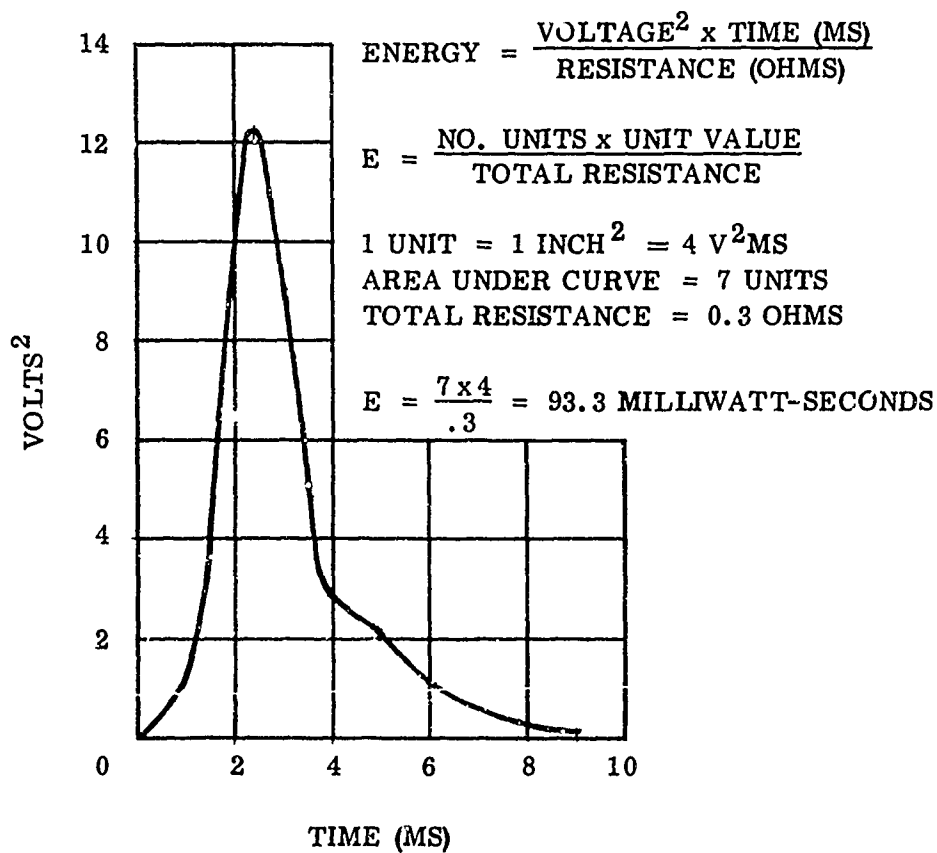
1. Operating Temperature Limits -65°F. to +200°F.

The generator is a manually operated automatically reset device designed to generate sufficient electrical energy to fire specified electric ignition elements used in electrically initiated propellant actuated devices.

PULSE GENERATOR (Cont'd)



TYPICAL TRACE OF PULSE GENERATOR OUTPUT

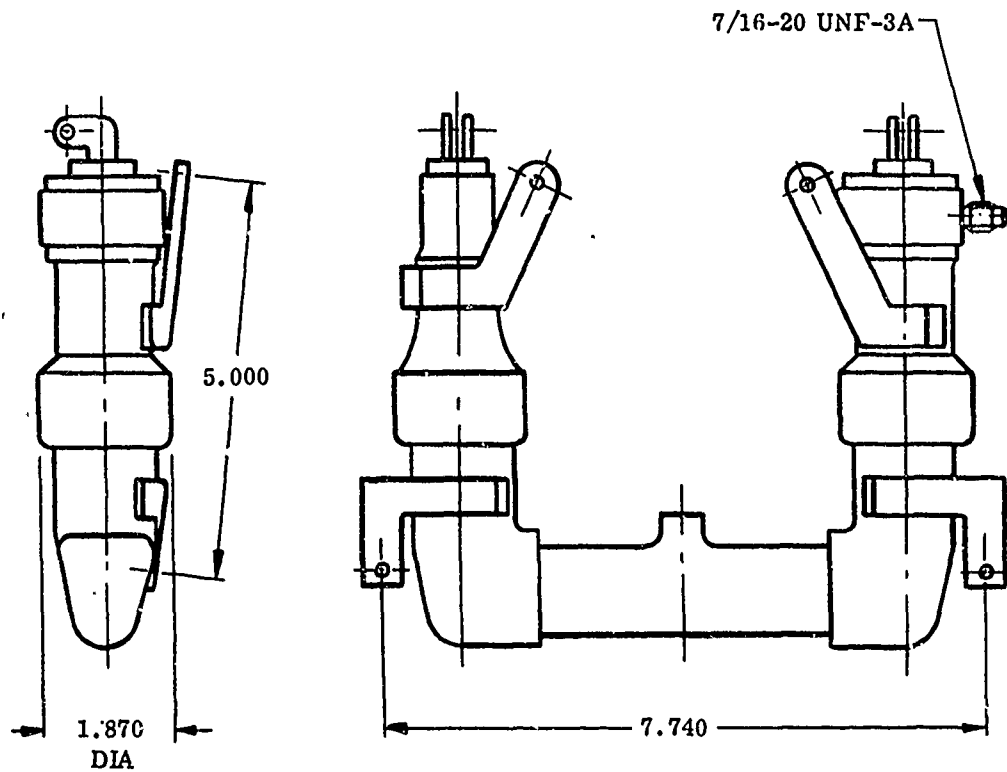


PLOT OF TYPICAL TRACE AND COMPUTATION OF ENERGY OUTPUT

GAS GENERATORS

The gas generators are primarily designed to supply gas pressure, for a longer sustained period of time than initiators to initiate, inflate, pressurize or otherwise serve as a self-contained propellant generating system. The items illustrated were designed for a specific purpose; however, gas generators can be designed to deliver propellant gas for a range of times from seconds to minutes. The delivered gas can also be filtered and temperature conditioned if required.

GENERATOR, GAS PRESSURE, XM-14



DATA

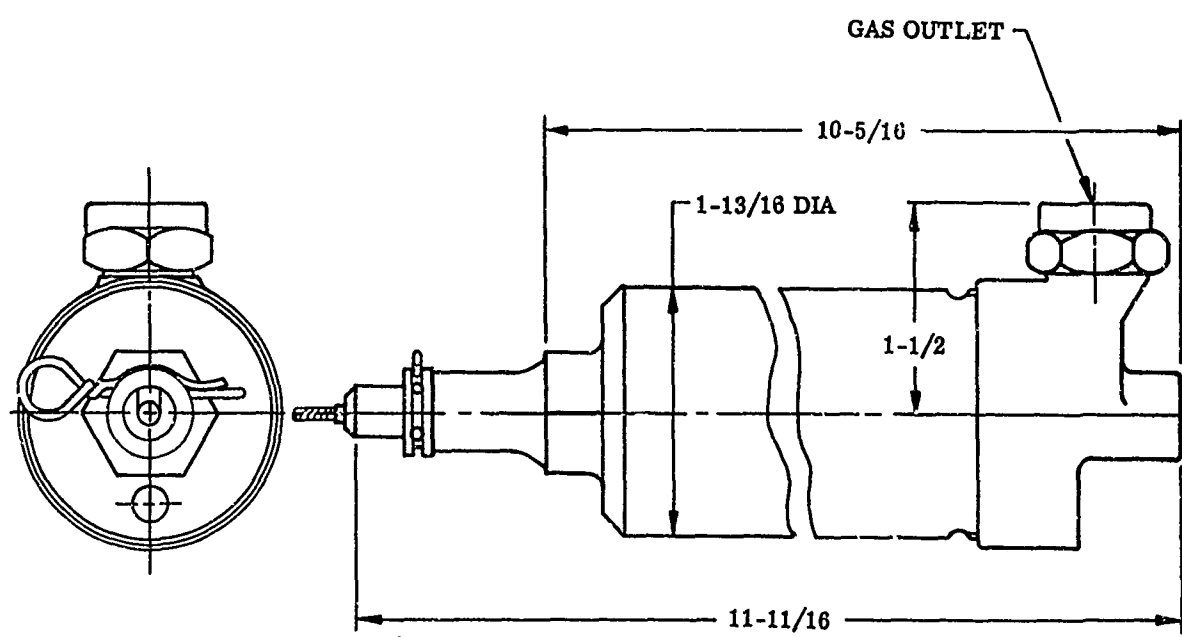
1. Weight:

Assembly	3-3/4 lbs.
Propellant	0.065 lb.
2. Burning Time 1.0 sec.
3. Gas Output:

Operating Pressure	1000 psig
Temperature	1600°F
4. Operating Temperature Limits -65°F + 200°F

This reusable, self-contained unit consists of two parallel chambers containing identical cartridges. For normal operation, one cartridge is mechanically actuated. The alternate cartridge, for use under certain conditions, has provisions for either gas or mechanical actuation. The cartridges are easily replaced. The generator is easily integrated into a system by means of standard fittings. This gas generator was designed to initiate the projection system in the capsule of the B-58 aircraft.

GENERATOR, GAS PRESSURE, XM-18

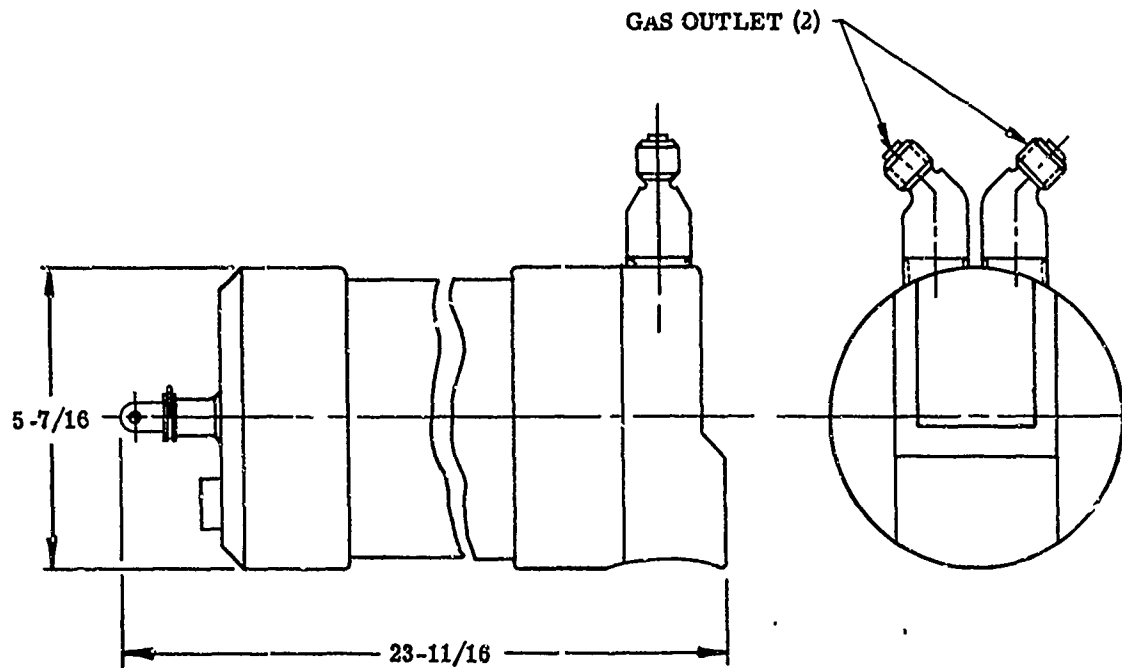


DATA

- 1. Weight of Assembly 2 lb.
- 2. Function Time 10 sec.
- 3. Gas Output Produces 5 std. cu. ft. of gas at a bulk temperature of 150° F.
- 4. Operating Temperature Limits -65° F. to +120° F.

This gas generator is a device designed to inflate a 1-man life raft.

GENERATOR, GAS PRESSURE, XM-20



DATA

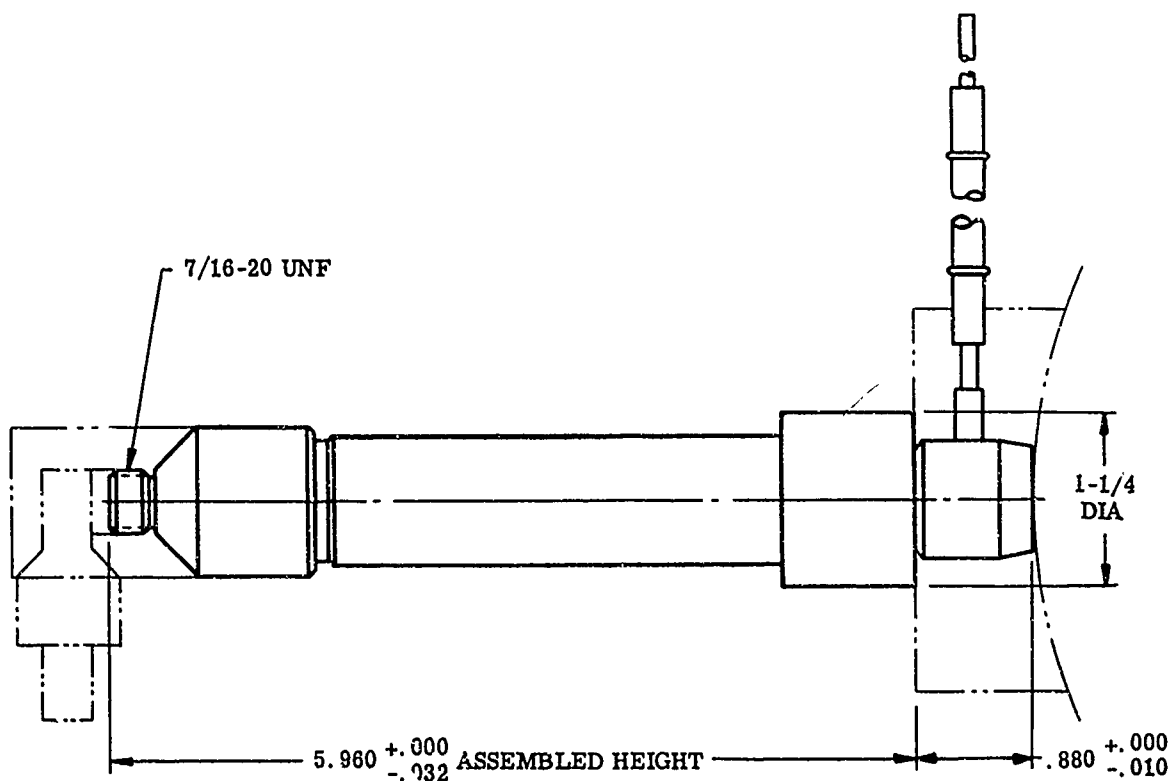
1. Weight of Assembly 28 lb.
2. Function Time 30 sec.
3. Gas Output Produces 80 std. cu. ft. of gas at a bulk temperature of 200° F.
4. Operating Temperature Limits -65° F. to +120° F.

This gas generator is a device designed to inflate a 20-man life raft.

MISCELLANEOUS ITEMS

The following items are not readily identifiable as to the nomenclature of the other propellant actuated devices and as such are listed separately as Miscellaneous items.

PENETRATION-EXTRACTION SYSTEM FOR UNEXPLODED ORDNANCE ITEMS

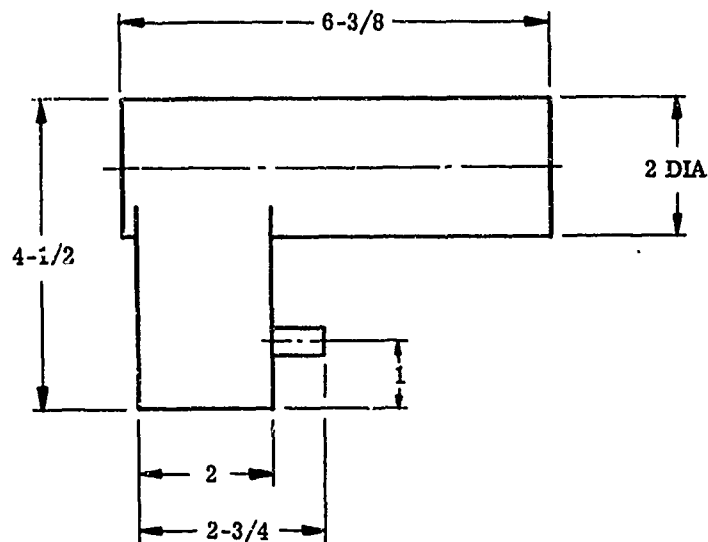


DATA

- | | |
|---|-----------------------|
| 1. Weight of Assembly | 2 lb. |
| 2. Function Time | 5 ms. |
| 3. Stroke | 2 in. |
| 4. Thrust (maximum) | Function of cartridge |
| 5. Energy (maximum) | Function of cartridge |
| 6. Velocity (maximum) | Function of cartridge |
| 7. Operating Temperature Limits | -65° F. to +160° F. |
| 8. Ejected Weight (Needle Extraction) | 0.10 lb. |

This penetration and extraction system is designed to penetrate and seal unexploded ordnance items. It can penetrate and seal items having an internal pressure of plus or minus several atmospheres; 0.040 to 0.750 inches of mild steel and 0.040 to 1.000 inches of aluminum can be penetrated and sealed.

INERTIA REEL, POWERED TAKE-UP, XM-1

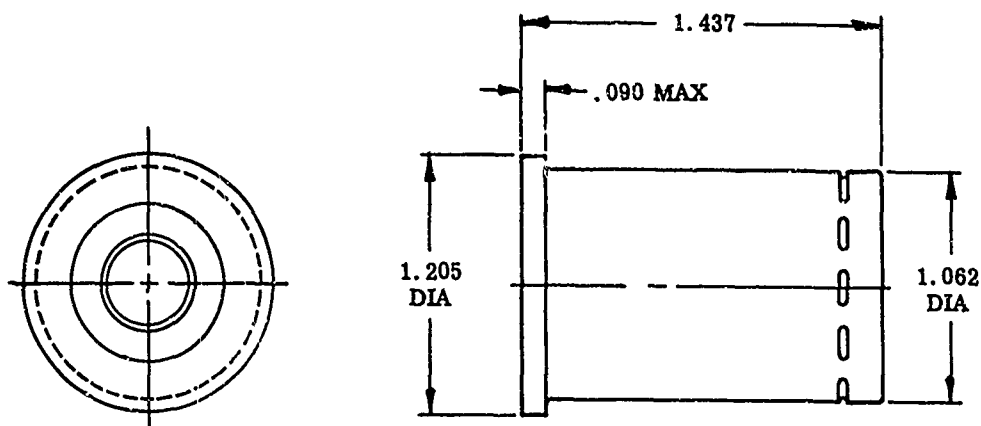


DATA

1. Weight of Assembly	3.25 lb.
2. Function Time	0.25 sec.
3. Three Revolutions	Rotary actuator
4. Energy (maximum)	400 ft-lb.
5. Operating Temperature Limits	-65° F. to +206° F

This power actuated inertia reel is a device designed to take up the personnel shoulder harness to position the pilot prior to ejection.

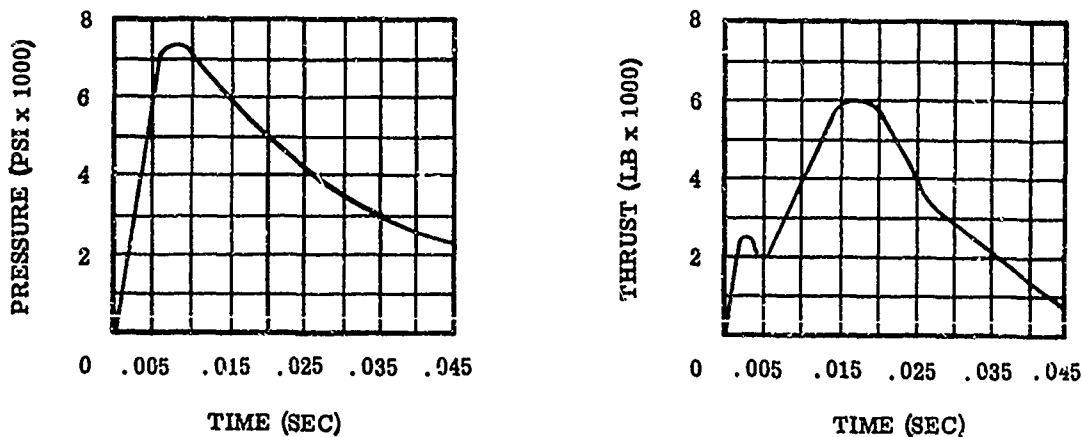
CARTRIDGE, BOMB EJECTION, CCU-1/B



DATA

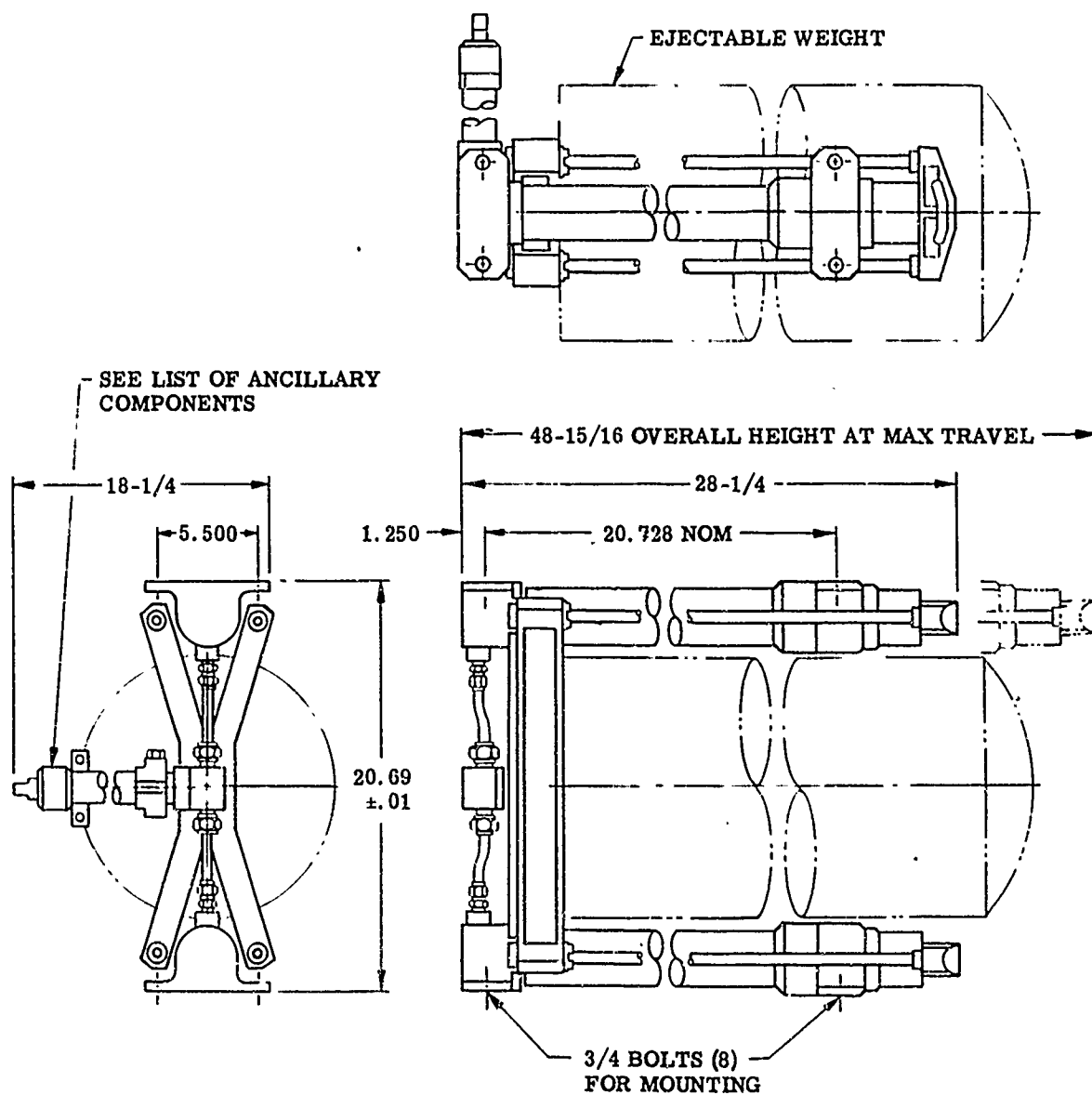
- | | |
|---|---|
| 1. Weight of Assembly | 30 grams |
| 2. Theoretical Energy | 5000 ft-lb. |
| 3. Ignition Element | Electric |
| 4. No Fire Current | One amp - One watt for 5 min. |
| 5. All Fire Current | 5 amp applied for 25 ms |
| 6. Operating Temperature Limits | -65° F. to +325° F. |
| 7. Propellant | 6 grams HMX/polyacrylate,
thermal resistant, extremely
clean and noncorrosive |

TYPICAL PERFORMANCE



This cartridge is a device designed for use on the MAU-12A/B bomb rack, the pressure, thrust, versu. time graphs shown represent the energy from two cartridges while ejecting a 500 pound store. The ballistic performance of this cartridge will vary with application.

EJECTOR, PLATFORM, PROPELLANT ACTUATED, XM-3



DATA

1. Weight of Assembly 105 lbs.
2. Function Time 0.040 sec. (40 ms.)
3. Stroke 18 in.
4. Thrust (maximum) 61,000 lbs.
5. Velocity (maximum) 100 ft./sec.
6. Operating Temperature Limits 70° F. (ambient)
7. Ejected Weight 340 lbs.

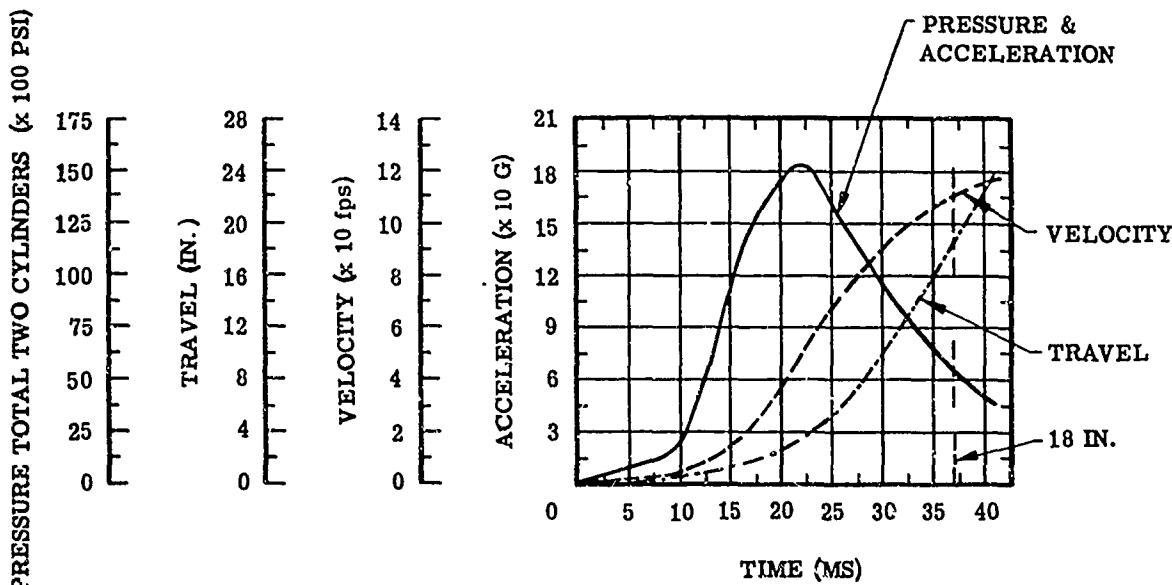
ANCILLARY COMPONENTS:

1. Generator, Gas Pressure, Propellant Actuated, XM-23.
2. Cartridge, Impulse, XM-228.

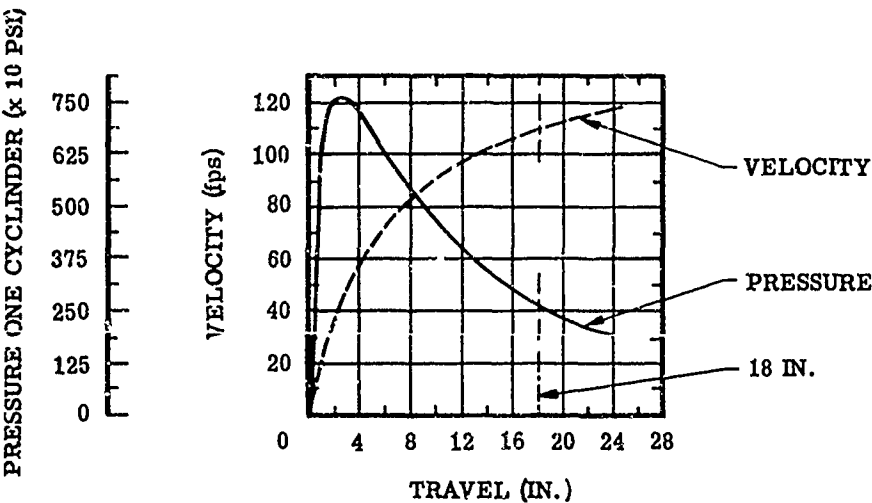
This ejector platform is a force-ejection mechanism used for upward ejection of weapon stores from low flying aircraft at speeds up to mach 2.0.

EJECTOR, PLATFORM, PROPELLANT ACTUATED, XM-3

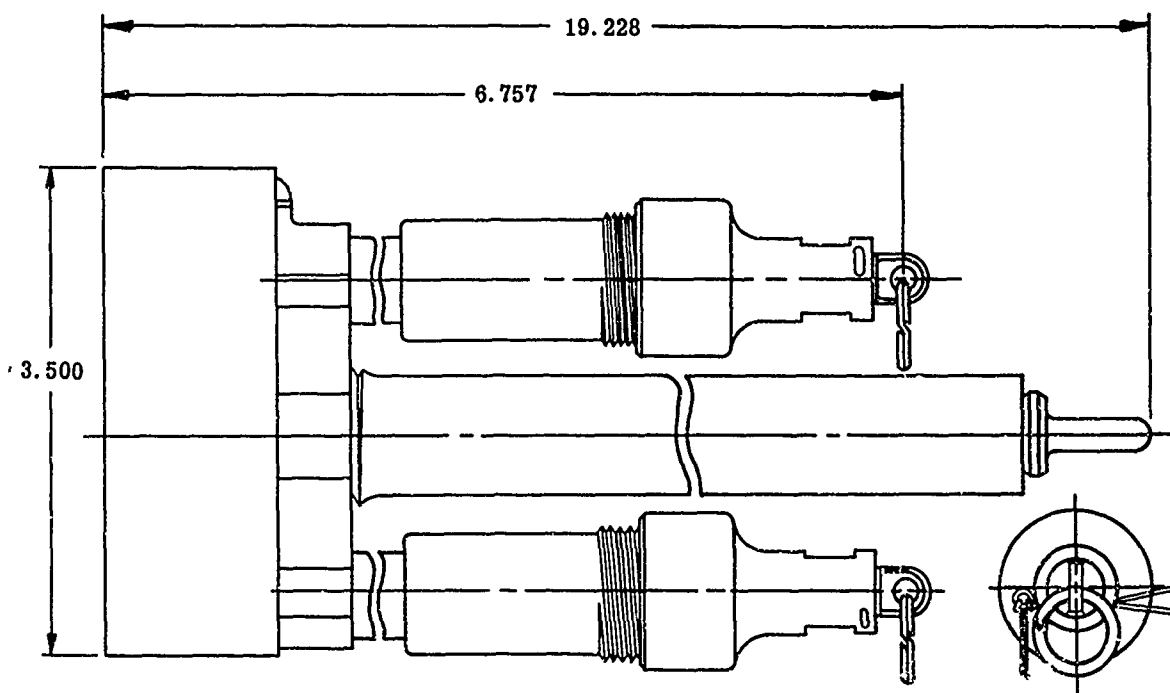
TYPICAL PRESSURE, TRAVEL, VELOCITY, AND ACCELERATION - TIME PERFORMANCE



TYPICAL PRESSURE, AND VELOCITY - TRAVEL PERFORMANCE



EJECTOR, PARACHUTE, CARTRIDGE ACTUATED, XM-233

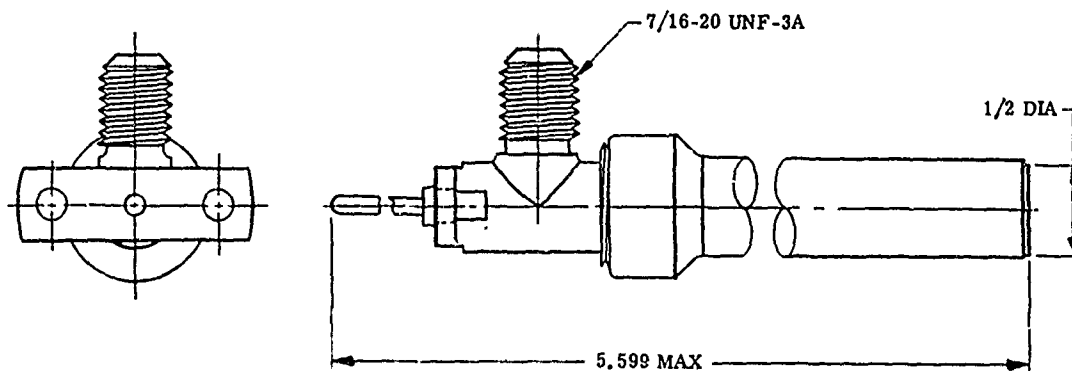


DATA

1. Weight of Assembly.....	2.16 lb.
2. Function Time	0.040 sec.
3. Stroke.....	16.44 inches
4. Thrust	825 lb.
5. Velocity (at full stroke).....	68 ft/sec.
6. Operating Temperature Limits	-65° F. to +200° F.

This ejector is a propellant actuated device specifically designed to ballistically deploy a personnel reserve (T-10 type) parachute.

RELEASE, FIRING PIN, M1A1

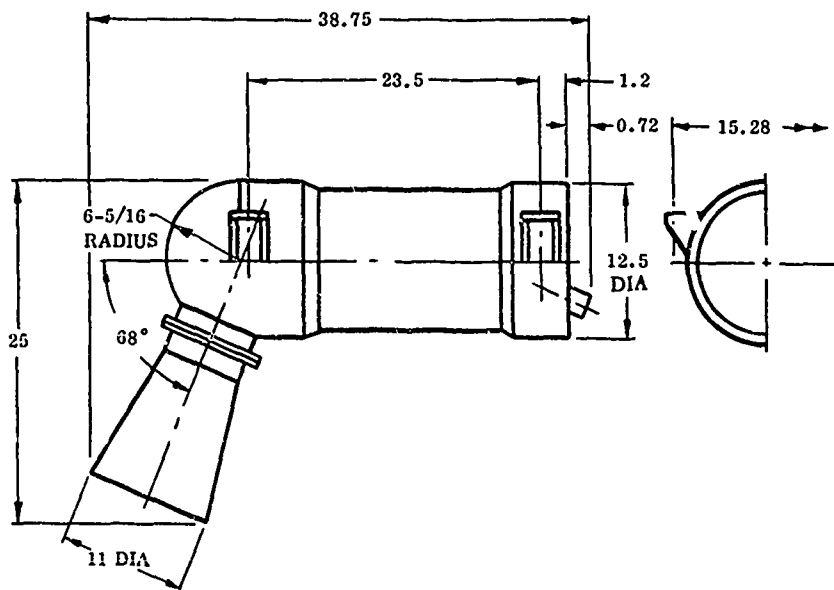


DATA

- | | |
|---------------------------------|----------------|
| 1. Actuation Method | Cas |
| 2. Actuation Pressure | 250 psi (min.) |

The M1A1 Firing Pin Release is gas actuated and releases the firing pin for such devices as the M1A3 Remover. It is actuated by gas from another Propellant Actuated Device. The Firing Pin Release is installed in the following aircraft: B-57, F-6, -86, -100, -101, -102, -105, -106, MF-K and T-37. The part number for the M1A1 Release is 94-5-1.

ESCAPE ROCKET, XM-15



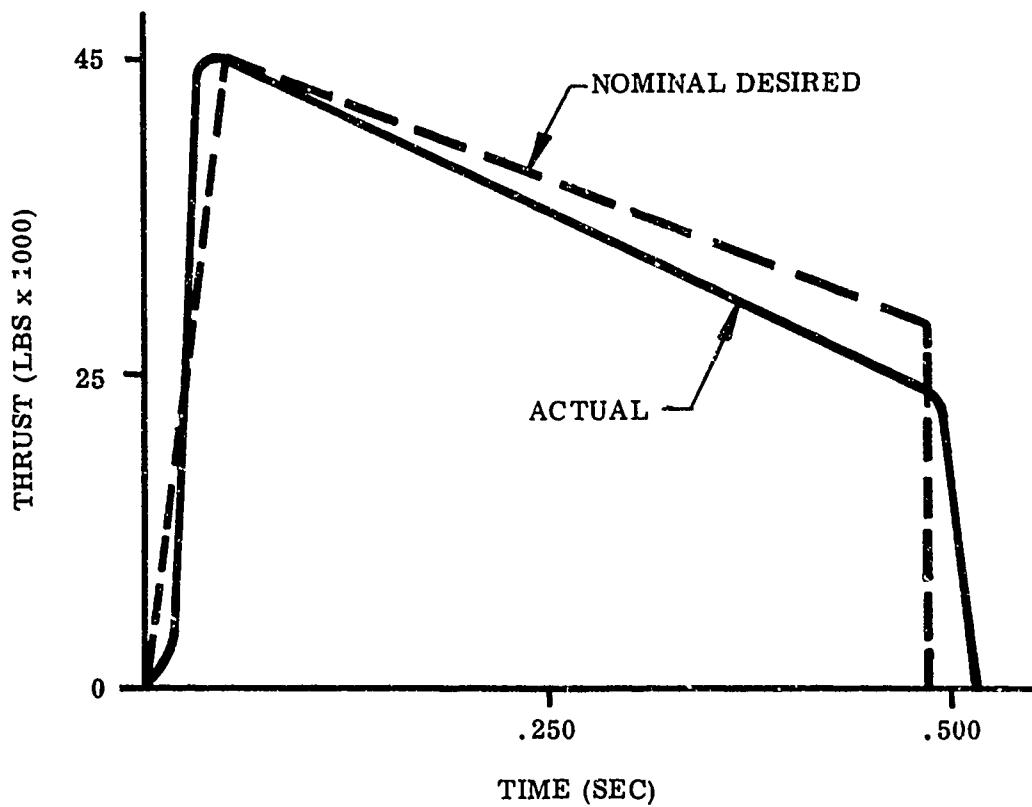
DATA:

1. Weight:		
Assembly	.....	133 lbs.
Propellant	.....	84 lbs.
2. Function Time	.....	0.500
3. Thrust:		
Min	.....	27,000 lbs. at 0.500 sec.
Max	.....	45,000 lbs. at 0.045 sec.
4. Impulse, nominal	.....	17,500 lbs. sec
5. Operating Temperature Limit	.....	+70°F ±20°F
6. Firing Method	.....	Dual electric ignition
7. Propelled Mass	.....	2400 lbs.

The XM15 Escape Rocket was designed to satisfy the ejection propulsion needs for a single place separable nose emergency crew escape capsule. It was used in the feasibility testing of the separable nose escape concept, the test capsule being based on the F104 aircraft configuration.

ESCAPE ROCKET, XM-15 (Cont'd)

TIME PERFORMANCE



OTHER DATA	TARGET	MEAN	σ *
Thrust Max., lbs.	45,000	42,344	901.5
Total Impulse, lbs. sec.	17,500	17,250	140.5
Burning Time, sec.	.500	.497	.013
Thrust Alignment	$\pm 0^\circ 31'$	$\pm 0^\circ 4'$	$0^\circ 2.4'$

* Based on five Static Tests.